STONE TOOLS IN THE PALEOLITHIC AND NEOLITHIC NEAR EAST

Stone Tools in the Paleolithic and Neolithic Near East: A Guide surveys the lithic record for the East Mediterranean Levant (Lebanon, Syria, Israel, Jordan, and adjacent territories) from the earliest times to 6,500 years ago. It is intended both as an introduction to the lithic evidence for students and as a resource for researchers working with Paleolithic and Neolithic stone tool evidence. Written by a lithic analyst and flintknapper, this book systematically examines variation in technology, typology, and industries for the Lower, Middle, and Upper Paleolithic; the Epipaleolithic; and the Neolithic periods in the Near East. It is extensively illustrated with drawings of stone tools. In addition to surveying the lithic evidence, the book also considers ways in which the archaeological treatment of this evidence could be changed to make it more relevant to major issues in human origins research. A final chapter shows how changes in stone tool designs point to increasing human dependence on stone tools across the long sweep of Stone Age prehistory.

John J. Shea is Professor of Anthropology at Stony Brook University. He has conducted archaeological research at Stone Age sites in the Near East (Israel, Jordan, and Egypt) as well as in Eastern Africa (Eritrea, Ethiopia, Kenya, and Tanzania). Shea is also a professional flintknapper (one who makes replicas of stone tools) and has demonstrated these and other skills involving Stone Age technologies in numerous television documentaries. He is the co-author and co-editor of several books, most recently *Out of Africa 1: The First Hominin Colonization of Eurasia* (2010). His papers have been published in *American Scientist*, *Current Anthropology*, *The Journal of Human Evolution*, *Evolutionary Anthropology*, *Paléorient*, and *The Journal of the Israel Prehistoric Society*.

STONE TOOLS IN THE PALEOLITHIC AND NEOLITHIC NEAR EAST
A GUIDE

JOHN J. SHEA
Stony Brook University

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town,
Singapore, São Paulo, Delhi, Mexico City

Cambridge University Press
32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org
Information on this title: www.cambridge.org/9781107006980

First published 2013

Printed in the United States of America

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging in Publication data

Shea, John J. (John Joseph) author.
Stone tools in the Paleolithic and Neolithic near East : a guide / John J. Shea, Stony Brook University.
pages ; cm.
Includes bibliographical references and index.
ISBN 978-1-107-00698-0 (hardback)
1. Paleolithic period–Middle East. 2. Neolithic period–Middle East. 3. Tools, Prehistoric–Middle East. 4. Stone implements–Middle East. 5. Middle Eastx–Antiquities. I. Title.
GN772.32.N4S54 2012 939.4–dc23 2012037770

ISBN 978-1-107-00698-0 Hardback

For Glynn Isaac, Ofer Bar-Yosef, and George H. Odell, but most of all, for Pat.

CONTENTS

LIST OF TABLES, FIGURES, AND BOX

TABLES

FIGURES

BOX

PREFACE

My main goal in writing this book is to create the kind of resource that I wish had been available when I began my studies of Near Eastern prehistory. Many of those who study the prehistory of the East Mediterranean Levant (a term I use in preference to "Near East") come to the subject because they are either from that region and/or because they harbor a specific interest in some topic to which the Levantine archaeological record is particularly germane. This was not how I ended up in Levantine prehistory.

In 1984, I arrived in graduate school planning to study the earlier phases of African prehistory with Glynn Isaac. It was a head-spinning first year because Glynn had invited a veritable pantheon of prehistorians to be scholars in residence. Among them was the Israeli archaeologist, Ofer Bar-Yosef. As a good host, Glynn insisted his students read up on Ofer's recent research on the Middle-Upper Paleolithic Transition. After I had read one of these papers (not one by Ofer), Glynn asked me what I thought. I opined that it was the most boring paper I had read all year, and I implored him not to make me do my dissertation on the Middle-Upper Paleolithic Transition or the prehistory of the Levant.

Looking back, I recognize the value of that paper. The problem was that I had plunged into a complex debate about lithic variability without any guide to the terminology or the major interpretive issues. I knew a lot about stone tools before I started graduate school. I knew how to make them. I knew how to use them. And I knew a lot about allied aspects of "primitive" (i.e., ancestral) technology. Thanks to Barbara Isaac, I had also learned how to draw them. The problem was that the archaeological literature about stone tools was written in a jargon that I did not understand. Glynn recognized this gap in my education and promised that we would go over formal typology the following Fall. Meanwhile, he had arranged for me to excavate at a Middle Paleolithic site in Israel and to study stone tools at the Hebrew University in Jerusalem.

Glynn died that Fall, and so we were never able to do that lithic typology tutorial. Instead, Ofer Bar-Yosef oversaw my continued education in Paleolithic archaeology and the completion of my doctoral research at Harvard. Over the course of my studies with Ofer, I realized that there was no single, comprehensive guide to the lithic record of the Near East. Instead, the lithic evidence for each prehistoric period was organized idiosyncratically. Sometimes systematics followed European models, in other cases African ones, or ones of indigenous Levantine origins. Making sense of the lithic record for this relatively small region required me to delve deeply into the prehistory of North and East Africa, and Europe as well. This was, for me, kind of an odd errand. On the one hand, it was transparently clear that the artifact-types and industries archaeologists were using to describe the lithic record had no clear middle-range theoretical basis linking them to the important "big questions" in human origins research. That particular named stone tool types correspond to mental templates of prehistoric toolmakers or that differences among named lithic industries reflect differences among prehistoric societies would be hilarious were it not that so much of what archaeologists have written about stone tools assumes these things are true. On the other hand, if one wants to use the lithic record to answer questions of larger anthropological interest, one has to know how that evidence was organized in the archaeological literature. Thus, in the course of writing this book, I would often find myself writing about traditional lithic typology and industrial systematics in the morning and railing against them in afternoon lectures. In the end, what helped me square this particular circle was the realization that this book is as much an ethnography of what archaeologists have done with Paleolithic and Neolithic stone tools of the Near East as it is a guide to the tools themselves. If it achieves its best-hoped-for purpose, this book will be a stepping-stone. It will help students and other scholars get "up to speed" on the lithic record of the prehistoric Levant so that they can make that record more relevant to major issues in prehistory and human origins research.

A preface is an opportunity to thank those who contributed to the scholarship on display in this work. For guiding my unfocused undergraduate interest toward lithic technology and the archaeology of human origins, I thank Creighton Gabel, Misia Landau, Ed Wilmsen, and James Wiseman of Boston University. Dr. Wiseman and Barbara Luedtke bent the rules a bit to allow me, then a senior, to attend a graduate-level seminar on lithic analysis at Massachusetts Institute of Technology. (I am doubly grateful for this rule-bending, because I met my future wife, Patricia, at that seminar.) I thank Richard "Scotty" MacNeish and George Odell for teaching me how to do archaeology in the field and in the lab and for encouraging me to continue my education. For taking a chance on a graduate student with more than a few rough edges, I thank Glynn Isaac and Barbara Isaac. For continuing the job they started at Harvard, I thank Ofer Bar-Yosef. I also thank David Pilbeam, K. C. Chang, and Irv DeVore. I learned more from them than they thought I did at the time.

The writing of this book has profited from fruitful discussions (and arguments) with many colleagues. I thank Daniel Adler, Daniella Bar-Yosef Mayer, Anna Belfer-Cohen, Jennifer Everhart, John Fleagle, Naama Goren-Inbar, Nigel Goring-Morris, Erella Hovers, Dan Kaufman, Ian Kuijt, Dan Lieberman, Lilliane Meignen, Paul Mellars, Danny Nadel, James L. Phillips, Avraham Ronen, Steven Rosen, Alan Simmons, Mathew Sisk, and Katheryn Twiss. In naming them, I hasten to add that in no way are they responsible for any of the opinions expressed herein or any errors.

For general encouragement along the way I thank Nancy Franklin.

Above all, I thank my wife, Patricia Crawford.

Stony Brook, New York
2012

1

INTRODUCTION

1. STONE TOOLS

Stone tools, or lithics, are the least familiar artifacts archaeologists encounter in our research. Most of us have more than a passing acquaintance with artifacts made of ceramics or metal. We have household words for them, such as "bowl" or "nail," that transfer readily into archaeological analysis. Few students come to archaeology already familiar with stone tools. When and where preservation of organic remains is poor, however, stone tools may be the only remaining evidence of prehistoric human behavior. Because they are so well preserved – indeed, nearly indestructible – stone tools are common touchstones for comparisons of human and hominin behavior across vast expanses of time and space. Plio-Pleistocene sites in East Africa and Near Eastern Neolithic villages have little else in common with one another, other than a lithic archaeological record.

Stone tools were not necessarily the most important artifacts in the lives of prehistoric humans. Recent humans who make and use stone tools often did not give these artifacts a second thought after having made, used, and discarded them (Holdaway and Douglas 2012). Archaeologists, in contrast, devote vast amounts of time and energy to excavating, measuring, drawing, and analyzing lithic artifacts, all in the hope of reconstructing significant dimensions of prehistoric human behavior (Andrefsky 2005, Brézillon 1977, Inizan et al. 1999, Odell 2004). To understand the prehistory of any region, archaeology students have to learn to identify dozens of stone artifact-types.

Inevitably, questions arise. Why do we make so many measurements of Acheulian handaxes? Why do we recognize two dozen different kinds of Middle Paleolithic scrapers but only one type of denticulate? Were all Neolithic "arrowheads" actually projectile points? When students ask such questions, all too often the response merely invokes research traditions for a particular region and/or time period. ("That is what my professors taught me, and this is what you need to learn.") The assumptions of behavioral significance underlying our conventions for describing the lithic evidence are too rarely made explicit.

This book is a guide to the lithic archaeological record for the Paleolithic and the Neolithic periods in the Near East, or in less Eurocentric terms, the East Mediterranean Levant. This region encompasses Lebanon, Syria, Israel, Jordan, the Sinai, and parts of adjacent countries. To archaeologists working in the later phases or prehistory, this region is also known as the "western wing" of the "Fertile Crescent." The Levantine Paleolithic Period began more than 1.4 million years ago with early hominin migrations out of Africa and lasted until about 10,500 years ago. The Neolithic Period (10,500–6,000 years ago) witnessed the transformation of hunter-gatherers into village-dwelling farmers and herders. Archaeologists have been researching the prehistory of the Levant for more than a century. Few other parts of the world of equal size have so rich an archaeological record for human biological, behavioral, and cultural evolution. Stone tools are the most durable components of this record, and differing interpretations of the lithic evidence lie at the heart of many major issues in Levantine prehistory. Surprisingly, however, there is no single comprehensive reference for the Levantine lithic record.

Stone Tools in the Paleolithic and Neolithic Near East is intended as a reference work for those beginning their studies in Levantine prehistory and for experienced researchers seeking an efficient way to become familiar with the lithic record for this region. Chapter-by-chapter, this book identifies the stone artifacts that mark the periods of Levantine Stone Age prehistory and it reviews how archaeologists have organized the lithic record for each of these periods. This book is not a comprehensive prehistory of the Levant. The time has long since passed when prehistory was a story "written in stone." Nevertheless, stone tools have been, for better or worse, the principal documents of prehistory. To understand many of the current debates about human evolution and prehistory, one needs to understand how archaeologists have organized the lithic record. This book focuses on the more utilitarian aspects of the lithic record (stone tools used by humans to interact with their physical environment): flaked stone and groundstone tools and vessels. The Levant's rich record of symbolic artifacts, which range from minute stone beads and statuettes to monoliths several meters high, lie beyond the scope of this work. Separating these symbolic artifacts from the present work does not imply that these beads, statues, and architectural structures are unimportant. The amount of labor invested in them clearly implies they were. Instead, excluding them merely reflects current archaeological practice in which "lithics" are generally understood to refer to utilitarian artifacts.

In writing *Stone Tools in the Paleolithic and Neolithic Near East*, I have tried to create the kind of reference work that I wish had been available when I began studying Levantine prehistory. The vast and complex body of literature on stone tool typology was one of the major obstacles I encountered in studying archaeological lithic analysis. The conventions for describing stone tools varied from region to region. The typologies I learned in courses on African archaeology were of little help in courses on the prehistory of the Eurasia. They also varied between time periods in the same region. Conventions for describing Levantine Middle Paleolithic stone tools differed widely from those used to characterize Upper Paleolithic and Neolithic tools. Becoming conversant about the lithic record for Levantine prehistory required me to track down a wide range of references written in several languages (mainly English, French, and German). Today, the Internet has made it vastly easier for students to find these publications, but synthesizing them remains a formidable challenge.

Archaeology is a constant dialog between the past and the present. The past gives us questions. Our experience of the present, guided by uniformitarianism and other scientific principles, furnishes us with answers and new questions. In practical terms, this means that archaeologists' life experiences color their perceptions about the past. If one has not tried to make stone tools, one could delude oneself that it is difficult. It isn't, and in fact, as this work will show again and again, much of the perceived complexity of the lithic archaeological record reflects archaeological theory, method, and practice, rather than the intrinsic underlying complexity of the stone tools themselves.

Because my experience with stone tools is atypical for an archaeologist, it is important to explain this to the reader at the outset. Long before I ever thought to study the prehistory of the Levant, I became interested in stone tools and other aspects of "primitive" technology. Learning how to make stone tools was a natural extension of the countless hours I spent as a child "playing Indian" in the woods of New England. Films showing Louis Leakey making and using stone tools in East Africa convinced me that I could do this too. Seeing the basic knapping techniques illustrated in F. Clark Howell's (1968) *Early Man* and Jacques Bordaz's (1970) *Tools of the Old and New Stone Age* increased my interest in lithic technology. Studying archaeology in college, I was surprised that few archaeologists who studied stone tools were also flintknappers. Nevertheless, I was happy to learn that many researchers valued insights gained by experiments making and using stone artifacts. Several of my professors encouraged me to become proficient at making and using stone tools. Flintknapping and stone tool use provided me with a wide range of contemporary experiences from which to derive hypotheses and tests of hypotheses about the past. It was tempting to think of these hypotheses as qualitatively better than those originating from other sources, but I also learned from several of those same professors that the value of a scientific hypotheses is not the source from which it is derived, but instead how well the hypothesis explains variability in the archaeological record.

The goal of this book is to provide a basic guide to the identification of stone tools from the Paleolithic and Neolithic periods in the East Mediterranean Levant. In trying to summarize this evidence I have had to focus on points of agreement among researchers and pay less attention to minor points of disagreement among specialists. Where necessary, I discuss these disagreements, but my emphasis is on those aspects of the lithic record that are accepted by most researchers. Specialists in one or another period will recognize that this work does not dwell much on controversies about how to measure particular stone tool types or which of the various typological and technological indices of lithic variability to use. In my judgment, the literature relevant to these topics is too vast and too contentious to cram into a basic reference work. Readers interested in these subjects will find guidance in the primary literature referenced in this work.

Stone tool analysis has a significant visual component. To make this book valuable as a reference, I drafted many artifact illustrations (more, indeed, than could be included in the book and still have it be an affordable publication). Cambridge University Press (CUP) has generously arranged for images that had to be cut from the final version of the book to be posted on their website at www.cambridge.org/9781107006980. In the text, these images will be cited and enumerated as "CUP Website Images."

II. CHRONOLOGY AND GEOGRAPHY

Stone Age Chronology

Most of the dates in this book are expressed in terms of years before the present (the International Radiometric Year, or 1950 AD). Dates in millions of years ago are abbreviated "Ma" (e.g., 2,500,000 years ago = 2.5 Ma). Dates less than 0.3 Ma and derived from methods other than radiocarbon are expressed in thousands of years ago, or "Ka" (e.g., 128,000 years ago = 128 Ka). When the given dates are calibrated radiocarbon dates, they are designated as "Ka cal. BP." Uncalibrated radiocarbon dates are written out (e.g., 25,000 bp). Chapter 7 on the Neolithic period also presents dates in terms of the Christian calendar, either as years bc (uncalibrated radiocarbon years) or BC (radiocarbon years calibrated into calendar years), because they are expressed this way in much of the archaeological literature for that period.

Prehistoric archaeologists use both geological and archaeological chronological frameworks. Geological time is organized in chronostratigraphic units called "epochs." These epochs are defined and subdivided on the basis of specific changes in rock stratigraphy that, in principle, can be detected on a global scale and accurately dated by more than one geochronometric method. All but the very earliest archaeological evidence dates to either the Pleistocene Epoch (2.5 Ma to 12.5 Ka) or afterward. The richness and variability of the archaeological record for the Holocene Epoch (<12.5 Ka) is so much greater than for any period of equivalent duration in the Pleistocene that it is nearly universally subdivided into archaeological periods.

Archaeological periods are defined on the basis of change and variability in the contents of archaeological assemblages thought to reflect significant shifts in hominin behavior. Behavioral innovations take time to spread from one region to another, or may never take root beyond their area of evolutionary origin. Consequently, the nature of archaeological periods and their dates can vary between and within larger regions. (This can be seen most clearly in the Levantine Neolithic Period, covered in Chapter 7.)

Table 1.1 lists the major chronological periods discussed in this book and their dates for the Levant. These Levantine Stone Age prehistory divisions were defined late in the nineteenth century on the basis of the European lithic record. The Paleolithic was the period when stone was shaped mainly by fracture. The Neolithic Period saw abrasion (grinding and polishing) to shape stone tools. One could quibble about the continued utility of this periodization scheme, but it is so well entrenched in the archaeological literature that one has to employ it here.

The Geography of the Levant

The names this text uses for various aspects of Levantine geography are chosen for their precision alone, and not for any overt political purpose. Country and city names reflect their current American English spellings.

The modern-day Levant is the result of a collision of the African and Arabian plates that began around 24 Ma. Previously, Africa and Arabia/Eurasia were separated by a narrow oceanic passage, the Tethys Seaway. When the African, European, and Arabian plates closed off this seaway, they created the Mediterranean Basin. Limestone bedrock, the former sea bed, was thrust upward above sea level. Nodules of the flint that comprises so much of the lithic evidence for the Levant are derived from these limestone deposits. Caves formed in these limestone deposits as water percolated through them and dissolved them. Caves in karst limestone landscapes are frequent sources of spring activity, and thus magnets for human settlement. The favorable conditions caves afford for the preservation of organic remains are major factors in the richness of the Levant's archaeological record.

Beginning around 3–4 Ma, the east-west spreading of tectonic plates created two of the Levant's defining ecogeographic features,

Table 1.1. *Major Periods of Levantine Stone Age prehistory*

Period	Dates	Major Evolutionary Events
Lower Paleolithic	>1,400,000–245,000 BP (>1.4–0.3 Ma)	Origin of Genus Homo. Increased evidence for hominin carnivory. First hominin dispersals beyond Africa. Controlled use of fire begins.
Middle Paleolithic	245,000–45,000 BP (245–45 Ka cal. BP)	Origins of *Homo sapiens* and Neanderthals. *Homo sapiens* dispersal into southern Asia. First evidence of exosomatic symbol use (mineral pigments, personal adornments, burials). Evidence for systematic hunting of large game.
Upper Paleolithic	45,000–24,000 BP (45–24 Ka cal. BP)	*Homo sapiens* adaptive radiation into western Eurasia. Widening ecological niche including systematic collection of small game. Extinction of Neanderthals. First evidence of freestanding architecture.
Epipaleolithic	24,000–12,200 BP	Increasing sedentism and ecological intensification among hunter-gatherers. Increased use of groundstone tools for in-bulk processing of wild grasses. Domestication of the wolf/dog.
Neolithic	12,200–6500 BP	Monumental architecture. Domestication of cereal grasses (wheat, barley). Domestication of sheep, goat, cattle. First villages, ceramics. Regional patterns of symbolic artifacts suggest organized religion.

the mountains of Lebanon and the Jordan Rift Valley (Figure 1.1) (Horowitz 1979). Extrusive volcanic rocks associated with these rifting and mountain-building processes (mostly basalts) were often used as raw materials for stone tools. (Anatolian obsidian was produced by more recent volcanic processes.) Running north-south, the Lebanon and Anti-Lebanon mountains trap rainfall from cyclonic belts traversing the Mediterranean Basin. Runoff from these mountains feeds a narrow but verdant strip of woodland habitats along the northern Levant coast. The subsidence of the Rift Valley created a series of lakes on the floor of the valley linked by the Jordan River. The higher and northernmost of these lakes (the Huleh and Kinneret basins) are freshwater, and thus attractive to plant and animal life, while those at lower elevations (e.g., the Dead Sea and its Pleistocene precursor, Lake Lisan) were, and remain, brackish.

For most of the past two million years, the Levant has enjoyed a broadly "Mediterranean" climate, characterized by long dry summers and short wet winters (Blondel and Aronson 1999). The decomposition of limestone and basalt bedrock under this climate regime led to the formation of clayey *terra rosa* sediments throughout much of the north and central Levant. In areas with more than 4,000–1,200 mm of rainfall per year, these sediments support woodland dominated by oak, terebinth, and pine (Figure 1.2). These woodlands' southern and eastern edges are ringed by "Irano-Turanian" steppe dominated by wormwood (*Artemisia*), various grasses, and Compositae. Further south, on more sandy substrates, *rendzina* and *loess* soils support sparse desert vegetation (Zohary 1973).

In much of the rest of Southwest Asia, woodland, steppe, and desert form broad, horizontally extensive vegetation belts. In the Levant, high topographic relief brings these ecozones into close conjunction. In some parts of Israel and Jordan, for example, it is possible to walk from dense woodland to steppe to desert in a few hours. This topographic effect formed extensive "ecotones" (transition zones between major ecogeographic communities) that would have been especially attractive to generalist feeders, such as early hominins. Populations living in such ecotones would have been able to minimize the logistical costs of simultaneously exploiting food sources in both woodland and steppe habitats.

The location and extent of the Levant's woodland, steppe, and desert ecotones varied widely through recent geological time. For most of recorded history, the northwestern Levant (Lebanon, coastal Turkey, western Syria, and northern Israel) has been persistently humid and hospitable to human habitation. Higher elevations in the southern Levant (the Negev, Sinai, and southern Jordan) have been steppe-desert and less supporting of prolonged and stable human settlement.

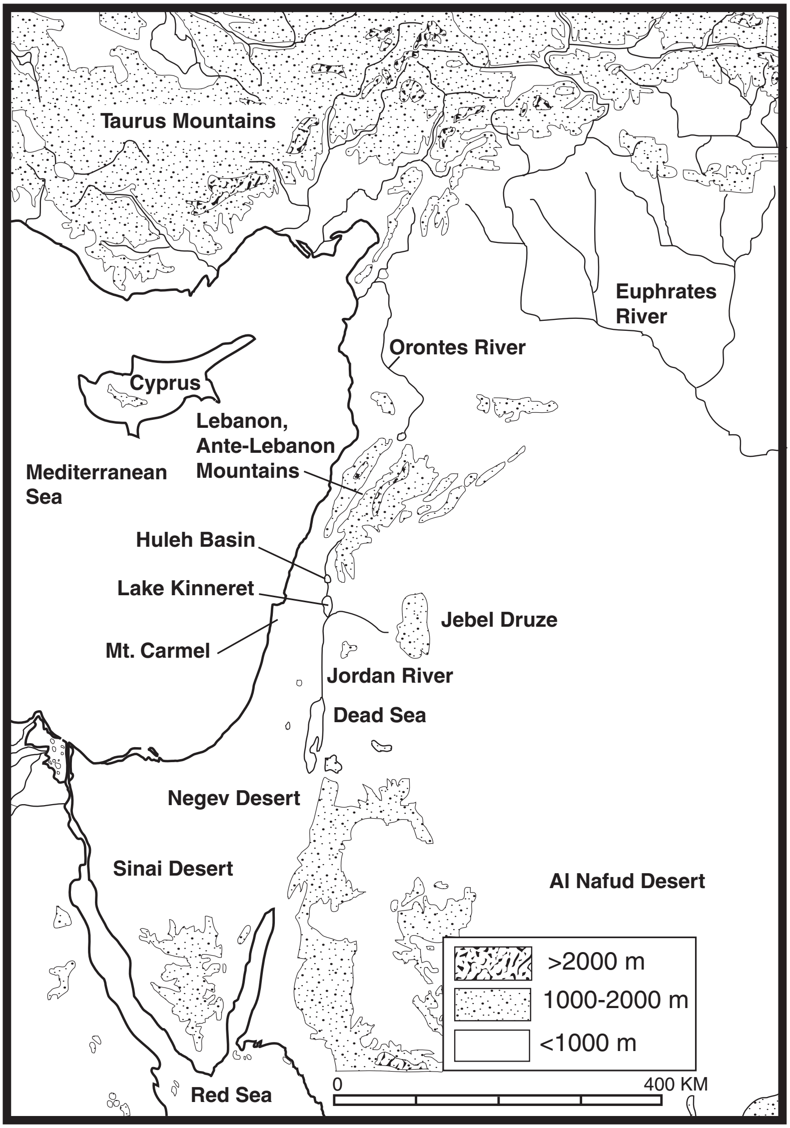


FIGURE 1.1. Topographic features of the East Mediterranean Levant.

Over the past 900,000 years, the Levant's climate has alternated along with Pleistocene glacial–interglacial cycles lasting roughly 120,000 years each. During short interglacial periods, the Levant was warm and humid, more or less like it is today. There is, however, considerable disagreement among paleoclimatologists over whether the region was relatively wet or dry during glacial episodes (Frumkin, Bar-Yosef, and Schwarcz 2011, McGarry et al. 2004).

The animal community of the Levant is a complex combination of endemic species (ones unique to the Levant), species that have dispersed into the region from elsewhere, and seasonal migrants (chiefly birds) (Tchernov 1988). The recent mammal community of the Near East is dominated by Palearctic species (species found mainly in temperate and colder parts of Eurasia), but Early Pleistocene times and warmer episodes during the Pleistocene witnessed infusions of species originating from North Africa and southern Asia.

From an anthropological and historical standpoint, the Levant has long been a crossroad of the continents, a corridor connecting Asia to Africa and the civilizations of the Mediterranean Basin to their counterparts along the Indian Ocean. Transfers of people, goods, and ideas across the Levant are richly documented from historical times. It stands to reason that similar kinds of phenomena graced at least the most recent phases of Levantine prehistory.

III. STONE TOOL ANALYSIS IN LEVANTINE PREHISTORY

Historical changes in archaeologists' methods for studying stone tools have caused mismatches between older conventions for describing stone tools and newly emerging analytical objectives. These methods can be discussed in terms of three chronologically sequential approaches: culture-stratigraphic approaches, culture-historical approaches, and behavioral-strategic approaches.

Culture-Stratigraphic Approaches

In the early twentieth century, when Levantine prehistoric archaeology began, human evolution was envisioned as a stage-wise progression. Many early prehistorians were originally trained in geology and paleontology, and in studying the archaeological record they looked for artifactual equivalents of paleontological "index fossils" that could indicate earlier humans' evolutionary status. Because hominin evolution was thought to be a linear course through more or less

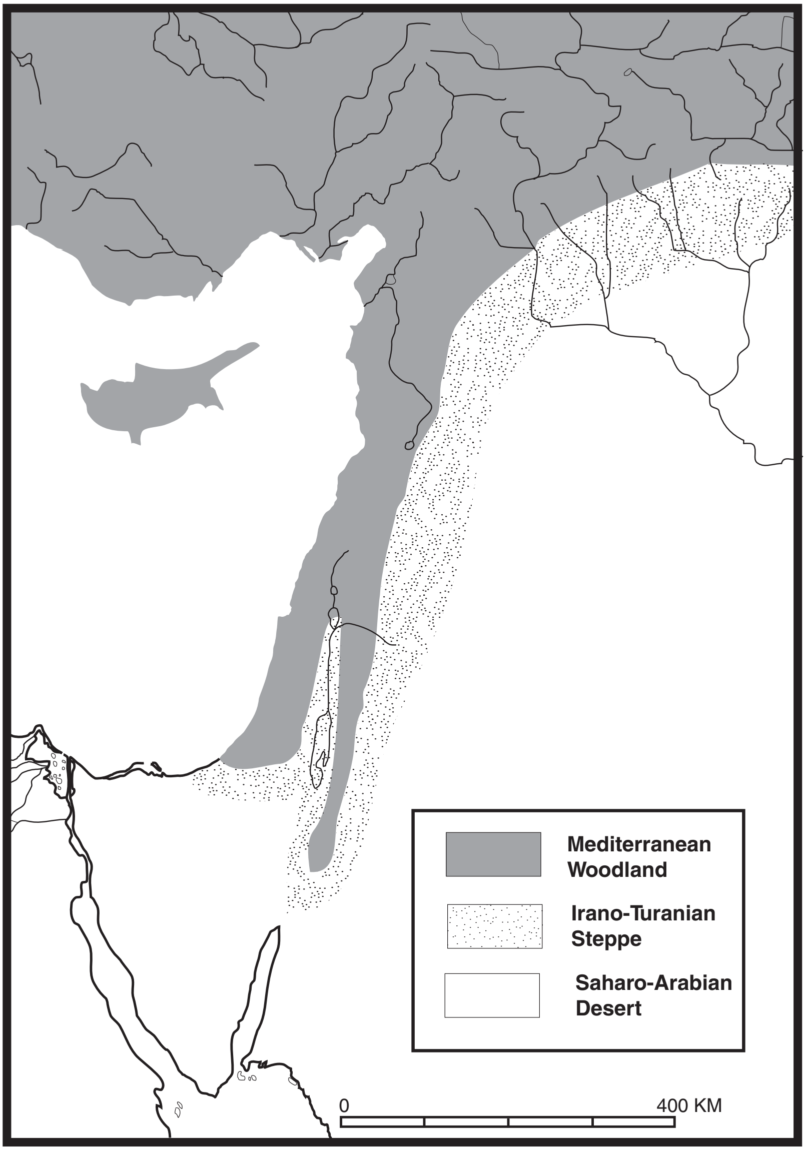


FIGURE 1.2. Ecozones of the East Mediterranean Levant.

universal stages, artifacts found in more recent contexts were accepted as evidence for their makers' having achieved a more advanced evolutionary condition. For example, Upper Paleolithic prismatic blades were seen as reflecting more "advanced" abilities than Middle

Paleolithic Levallois flakes, or Lower Paleolithic pebble-cores. Thus, finds of prismatic blades in Middle Paleolithic contexts were seen as evidence for the early origins of "modern" humans in the Levant (Garrod 1937c, Neuville 1934).

The use of lithic index fossils was a major theoretical innovation in prehistory. Unfortunately, it led many archaeologists to conserve only these diagnostic pieces and to discard many other artifacts in the field. We now know that these discarded artifacts contain valuable information about prehistoric human technological strategies. It was only much later, after the 1960s, that prehistorians working in the Levant systematically conserved nondiagnostic tools and unretouched "waste" (*débitage*) from their excavations.

Culture-Historical Approaches

In the second third of the twentieth century, multilinear evolutionary models became more popular in ethnology. Archaeologists responded by refocusing their efforts on tracing the history of individual evolutionary lineages. To do this, they followed prehistorians working in later periods in borrowing the "culture" concept from ethnology, equating groups of archaeological assemblages with culturally distinct groupings of prehistoric humans (e.g., Childe 1925). Archaeologists working during this period used the term "stone tool industry" and "culture" more or less interchangeably (e.g., Garrod 1932).

The methods by which Levantine and other prehistorians discovered these industries varied. In many cases, industries formerly identified through the index-fossil approach were simply retained and redefined in novel terms (Perrot 1968). Levantine archaeologists working with Lower and Middle Paleolithic evidence adopted Bordes's (1961) method of sorting assemblages into named assemblage-groups on the basis of relative frequency variation among a standardized list of artifact-types. Prehistorians working in later periods adopted a similar method using different artifact-types (e.g., Bar-Yosef 1970, Hours 1974). The lasting influence of this culture-historical approach can be seen in the argument that Levantine lithic assemblages can be grouped into distinct lithic "traditions" whose evolutionary fates can be traced across major evolutionary and technological "transitions" (Bar-Yosef 1980, Jelinek 1982b, Marks 1983b).

In basing inferences about assemblage variability on a wider range of artifacts, the assemblage/culture-history approach was an improvement over its predecessor. The practice of sorting assemblages on the basis of artifact-type relative frequencies, however, posed its own set of methodological problems. Most obviously, it assumed sample homogeneity – that lithic assemblages made by the same people would yield archaeological samples with similar statistical characteristics. This assumption ran counter to an increasingly robust ethnoarchaeological record showing seasonal variation in artifact production (Thomson 1939), technologically distinct lithic assemblages being created by different personnel within the same co-residential groups (Gould 1980, Holdaway and Douglas 2012), and wide variation in tool discard behavior across the surface of habitation sites (Binford 1982).

Behavioral-Strategic Approaches

Since the 1980s, lithic analysis in Levantine prehistory has increasingly developed in a more "behavioral-strategic" direction. These approaches place more emphasis on reconstructing particular aspects of prehistoric behavior and less on formal taxonomic divisions among lithic assemblages. Some aspects of these new directions in lithic analysis are borrowed directly from ethnology, others were imported from prehistoric research in other regions.

The operational chain (*chaîne opératoire*) approach is one example of a methodology borrowed from ethnology (Lemmonier 1986). Proponents of the operational chain approach attempt to reconstruct variation in strategies for procuring, transforming, using, and discarding stone tools from morphological and metric variation among stone artifacts (Boëda, Geneste, and Meignen 1990). Operational chain analyses draw heavily on contemporary social theory (Bourdieu 1977), and they strive to identify patterns of lithic variation referable to cultural differences among toolmakers (e.g., Bar-Yosef and Meignen 1992, Boëda 1991, Sellet 1993, Tostevin 2003).

Studies of lithic "technological organization" were imported to Levantine prehistory from regions where archaeology is strongly influenced by behavioral and evolutionary ecology (e.g., Bamforth and Bleed 1997; Kuhn 1993, 2004; Nelson 1988; Rolland and Dibble 1990; Shea 1998; Shott 1986; Surovell 2009; Torrence 1989; Wallace and Shea 2006). These studies focus on technological variation among cores, flakes, and retouched tools, related to "strategic" variation in raw material economy, mobility patterns, artifact designs, and tool curation. Most practitioners of technological organization approaches are less concerned with cultural differences among prehistoric toolmakers and more concerned with evaluating the relative significance of different behavioral factors, such as residential versus logistical mobility, and their correlated technological strategies in the formation of particular archaeological assemblages.

C*haîne opératoire* and technological organization approaches share a common concern for reconstructing human behavioral strategies from lithic variability. These perspectives are not incompatible with one another or with tenets of the unilinear evolutionary or culture-historical approaches. In fact, one does not need to look hard to find examples of index fossils, type-lists, and behavior-strategic analyses being discussed in the same papers and monographs.

IV. OVERVIEW

Regardless of their theoretical orientation, archaeologists need to discuss evidence. *Stone Tools in the Paleolithic and Neolithic Near East* is intended to assist archaeologists in recognizing, measuring, and describing variation in the lithic evidence from the Paleolithic and Neolithic periods in the East Mediterranean Levant.

Stone tools have impressive aesthetic qualities. The artisanry expressed in many Paleolithic and Neolithic artifacts equals, and arguably surpasses, no small amount of modern art. This being said, aesthetic judgments are not refutable scientific propositions. *Stone Tools in the Paleolithic and Neolithic Near East* treats its subject matter first and foremost from a scientific perspective. The artifact-types and lithic industries discussed here are heuristic devices of our own making and aids to understanding prehistoric human behavioral variability. They have no objective existence outside the framework of particular research questions. As scientists, we should have no compunctions about changing or discarding these analytical constructs if they fail to advance the science of prehistory. Before changing anything, though, one has to understand it. Change can be good, but change for its own sake leads to anarchy.

The ultimate goals of this book are to help change and improve archaeological lithic analysis in the Levant and to make archaeological lithic analysis more germane to the major issues in human evolution and prehistory. The Levantine record is neither uniquely advanced nor retrograde in this respect (Shea 2011e). Instead, it is for this author a convenient starting point. I originally trained as an Africanist, but circumstances resulted in my working in the Levant for many years. I view this book as a gift to other students of Levantine prehistory, a work that I hope will make their training in this subject easier than mine.

Chapter 2 provides a short introduction to basic concepts in stone tool technology and archaeological lithic analysis. First, it discusses the mechanical basis for shaping stone tools and the basic terms archaeologists use to describe lithic artifacts. It next surveys what archaeologists think we know about stone tools on the basis of experiments, from observations of recent stone-tool-using societies, and from contextual clues from the archaeological record itself (our "middle-range" theory). The main part of this chapter introduces key archaeological concepts in archaeological lithic analysis. It concludes by explaining the conventions used in the drawings of lithic artifacts in this book.

The next five chapters discuss the lithic evidence for the Lower Paleolithic (Chapter 3), Middle Paleolithic (Chapter 4), Upper Paleolithic (Chapter 5), Epipaleolithic (Chapter 6) and Neolithic periods (Chapter 7). Each chapter begins with a brief synopsis of the major evolutionary events in its subject period and a guide to the published literature on the period and its lithic evidence. Next follow systematic descriptions of each period's diagnostic core technologies, their characteristic byproducts. This is followed by a systematic review of typological variation among stone tools from that period. The higher-order groupings of lithic assemblages ("industries") currently recognized by Levantine prehistorians are also reviewed. Each chapter closes with recommendations about how archaeological treatment of the lithic record for the period could be improved.

Chapter 8 presents an overview of the major changes in the lithic record for Levantine prehistory and what we may plausibly infer from them about variability in hominin behavior. It also reviews some of the obstacles that stand in the way of the lithic record making more substantial contributions to Levantine prehistory.

Appendix 1 contains checklists of the major artifact types for different phases of Levantine prehistory.

Appendix 2 reviews the major conventions for measuring stone artifacts used by prehistoric archaeologists working in the Levant and elsewhere.

2

LITHICS BASICS

Archaeologists utilize four main sources of information about how stone tools were made and used. These include mechanical studies, experimental archaeology, ethnoarchaeology, and contextual clues from the archaeological record. Mechanical studies investigate the specific physical processes involved in tool production and wear. Experimental archaeology attempts to reproduce prehistoric tools and tool uses under controlled conditions. Ethnoarchaeology develops models for archaeological lithic variability by studying stone tool use by contemporary humans. Finally, contextual clues are patterns of association among stone tools and other residues in the archaeological record. This chapter pulls together insights from these sources to provide a basic introduction to lithic technology. It reviews the main descriptive categories of stone tools and their higher-order groupings as recognized by archaeologists. It also provides a brief overview of the major interpretive concepts in lithic analysis.

I. MECHANICS OF STONE TOOL TECHNOLOGY

Stone tools are shaped mainly by fracture and abrasion. Both of these processes involve an objective piece being loaded by an indenter until it "fails." Archaeologists' terms for conchoidal fracture products differ from those used in mechanics (Table 2.1). In lithic technology, the objective piece is called a core or a flake-tool. Force, or load, is transmitted by a hammerstone. The fracture products are called flakes or, collectively, *débitage* (French for "waste").

Table 2.1. *Essential Concepts in Fracture Mechanics, Flintknapping, and Lithic Analysis*

Definition	Fracture Mechanics	Flintknapping & Lithic Analysis
Object that transmits load	Indenter	Hammer, hammerstone, percussor
Object that fails under load	Objective piece	Core, flake-tool
Fracture product	Detached piece	Flake, flake fragment

Fracture

Fracture refers to a cleavage plane that forms when a brittle material breaks. Most Paleolithic and Neolithic stone tools were shaped by controlled conchoidal fracture. Conchoidal fractures form when compressive loading stress exceeds the tensile and compressive strength of a brittle material (Cotterell and Kamminga 1987). Conchoidal fractures occur in rocks that are both brittle and isotropic. Isotropy is the quality of responding to load equally in any direction.

Glass is a brittle isotropic material often used to research conchoidal fracture. Much of what we know about the mechanical basis of stone tool production comes from experiments investigating aspects of conchoidal fracture mechanics in glass (for an overview, see Dibble and Rezek 2009). Most of the conchoidally fracturing rocks shaped by prehistoric humans were cryptocrystalline silicates, rocks consisting mainly of quartz crystals that are too small to be seen with the naked eye. The most common such rocks used in the Levant were chert and flint, but prehistoric humans also used nonsilicate rocks (limestone and basalt), as well as noncrystalline rocks (obsidian or volcanic glass) and minerals (quartz crystals). Most lithic materials used as hammerstones are tough rocks, such as varieties of basalt, limestone, and quartzite that resist fracture initiation.

Much of the variability in conchoidal fracture arises during the initiation and termination of the fracture (Figure 2.1.a–b). Hertzian initiations begin when compressive force from an indenter creates a cone-like fracture (a "Hertzian cone") on the surface of the core. This fracture propagates under the side of the core, detaching itself with the resulting flake. Bending initiations occur when the edge of a stone artifact is loaded in such a way that the points of maximum compressive and tensile stresses are separate from one another. When this

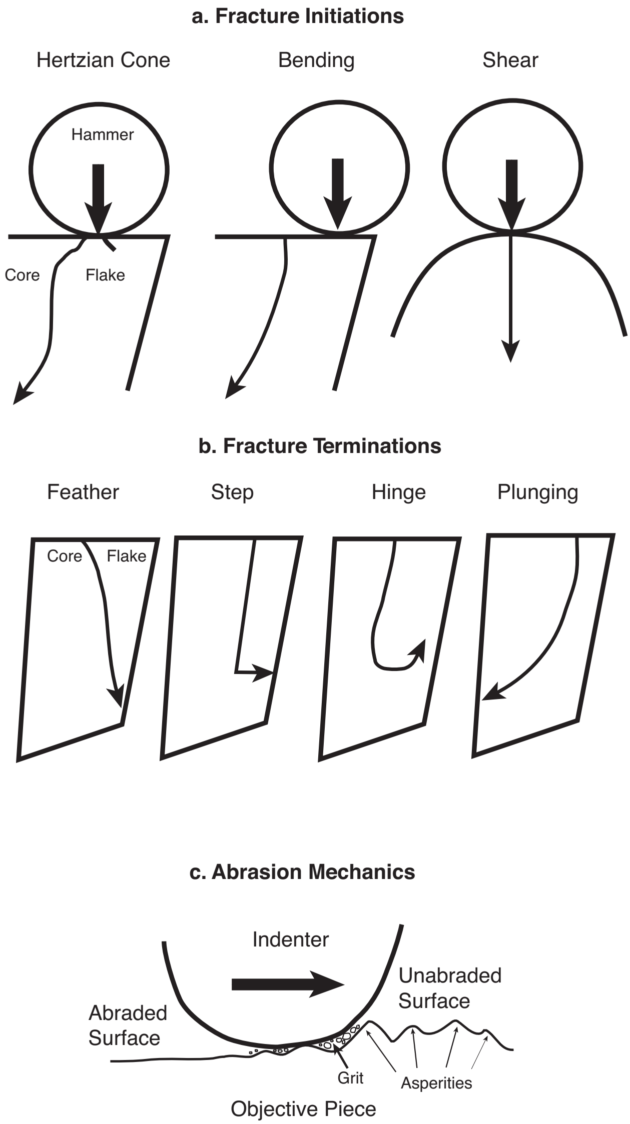


FIGURE 2.1. Conchoidal fracture initiation (top) and termination (middle), and abrasion mechanics (bottom).

happens, a fracture can form in an area under tensile stress located some distance from the point where the indenter comes in contact with the objective piece. Shear initiations occur when compressive stress creates a flat planar fracture directly under the indenter. Termination occurs when an expanding flake intersects the surface of the core. Fracture terminations are classified as "feather," "step," "hinge," and "plunging/overshot," depending on their trajectories and shapes in profile view. Fracture propagation (its length and trajectory) depends on many factors, including the structure of the rock (large versus small crystals, inclusions, and bedding planes) the morphology of the core surface, the amount of load and the rate at which it is applied, and the physical properties of the indenter and the degree to which the rock sample was immobilized during fracture propagation.

Archaeologists employ two main sets of contextual clues when reconstructing the specific patterns of fracture used in prehistory. The first of these involves reconstructing fracture propagation trajectories from the fissures, undulations, and other phenomena left on the fracture surfaces. The second is refitting analysis in which archaeologists reassemble artifacts split by fractures. Complex sets of such "refits" can shed light on the sequence by which a rock was modified by successive fractures.

Abrasion

Abrasion is damage that results from sliding contact between a rock and another surface. This sliding contact creates compressive and bending stresses on the small projections ("asperities") on the stone surface (Cotterell and Kamminga 1990: 151–159). As these projections are dislodged, they are dragged across the stone surface, creating pits and scratches ("striations") that in turn create additional asperities (Figure 2.1c). Abrasion can be accelerated by several methods: (1) by sliding the stone tool surface against harder, coarser materials; (2) by introducing hard, angular grit or sand between the tool and another surface; and (3) by using percussion or some other shaping process to roughen and weaken the surface of the tool. Abrasion processes can be altered by the addition of lubricating agents (e.g., water or oil) so that a smoothed or "polished" surface is created. Such polished edges lose less energy to friction during contact with worked materials, improving their cutting effectiveness. In many parts of the world, the edges of stone tools were (ground) polished to improve their cutting effectiveness.

Flintknapping

Many of the terms archaeologists use to describe stone tool production are borrowed from flintknapping. Historic flintknappers were craftsmen who produced gunflints, but flintknapping now refers to efforts to make and use replicas of prehistoric stone tools (Whittaker 1994). François Bordes (1969), Louis Leakey (1960), Don Crabtree (1972), and other twentieth-century archaeologists often described their own flintknapping and tool use experiments and used their impressions of the results to guide archaeological interpretations (Johnson 1978). The most archaeologically important flintknapping terms refer to different methods for initiating fractures (Figure 2.2). Hard-hammer and soft-hammer percussion refer to fracture initiation achieved by striking a core with an indenter made of either stone or metal ("hard-hammer") or bone, antler, or wood ("soft-hammer"). Pressure flaking refers to fracture initiation by slowly increasing loading with either a hard or soft indenter. Indirect percussion is a technique in which a knapper initiates a fracture by using a punch to focus energy from a hammerstone or some other percussor. Bipolar percussion involves initiating shear fractures by crushing a core between two stones. The anvil technique involves a knapper striking a core against a stationary stone percussor.

Modern-day flintknappers often use thermal alteration ("heat treatment") to improve the fracture and abrasion properties of a rock. Heating crystalline silicate rocks to 400–500°C and then slowly cooling them causes cracks to form in quartz crystals (Beauchamp and Purdy 1986, Inizan and Tixier 2000). These cracks weaken the rock, reducing the amount of force necessary to initiate and propagate a fracture. When such heat-treated rocks are knapped, fractures that would otherwise have passed around rock crystals instead propagate through them. Consequently, freshly knapped surfaces of heat-treated rocks are more brightly reflective (lustrous) than samples of the same rock that have not been thermally altered. Thermal alteration also usually changes the color of the rock, but this quality varies with rock chemistry. Until recently, thermal treatment was thought to be a recent (i.e., Late Pleistocene or Holocene age) phenomenon, but the practice is now known from later Middle Pleistocene contexts in southern Africa (Brown et al. 2009).

II. KEY DESCRIPTIVE CONCEPTS IN ARCHAEOLOGICAL LITHIC ANALYSIS

Archaeological lithic analysis uses specialized terminology to describe stone tools and lithic variability (Brézillon 1977, Inizan et al. 1999). The following sections review the terms and related concepts from lithic analysis that are germane to Levantine Paleolithic and Neolithic stone tools.

Basic Terms for Lithic Artifacts

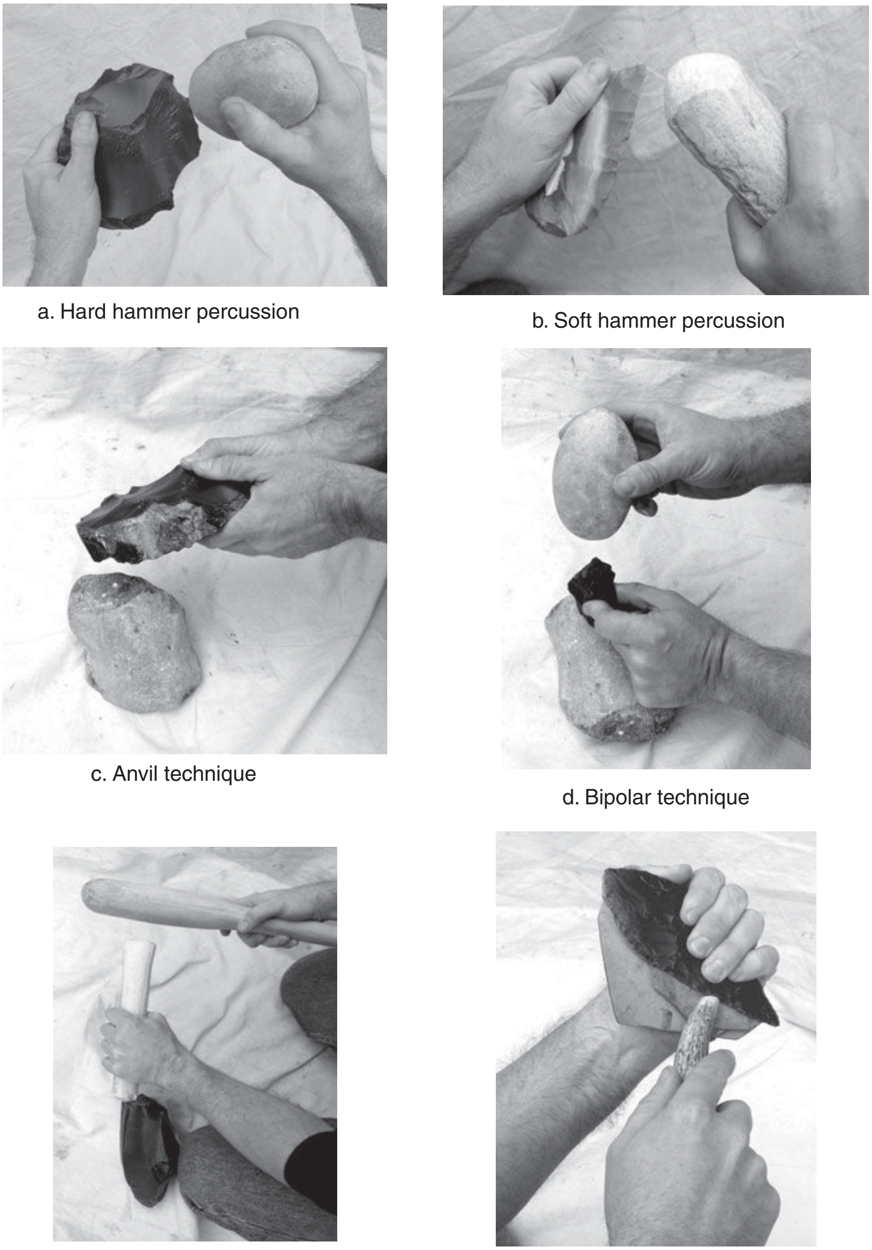
Most stone tools are created by initiating a fracture in a piece of rock by striking it with a hammerstone (Figure 2.3). The pieces of rock detached by conchoidal fracture are called flakes, and the rock from which they are detached is called a core. Archaeologists often use the French term *débitage* to refer collectively to unretouched flakes and flake fragments. Retouched tools are flakes or other detached pieces whose edges feature contiguous and overlapping clusters of small flake scars (retouch). Flintknappers retouch edges either to change the shape of the edge or to resharpen an edge dulled from use. Many archaeologists use the terms "tools" and "retouched tools" synonymously, even though ethnography and microwear analysis of archaeological specimens all show that people used flakes without retouching them. Some archaeologists also distinguish cores with seemingly use-related retouch and/or wear on some part of their circumference as "core-tools."

To depict stone tools, lithic analysts have preferred to use line art or drawings instead of photography. This is because many stone tools are either highly reflective or partly translucent. Digital image processing is leading to the increased use of photography, but the overwhelming majority of stone tools are shown in the archaeological literature as line drawings (see Box 2.1).

The major categories of archaeological stone tools are pounded pieces, cores, flakes and flake fragments, retouched tools, or groundstone tools.

Pounded Pieces

Pounded pieces are artifacts shaped by percussion. The damage caused by this percussion is called comminution – multiple overlapping,



a. Hard hammer percussion

b. Soft hammer percussion

c. Anvil technique

d. Bipolar technique

e. Indirect percussion

f. Pressure flaking

FIGURE 2.2. Knapping techniques.

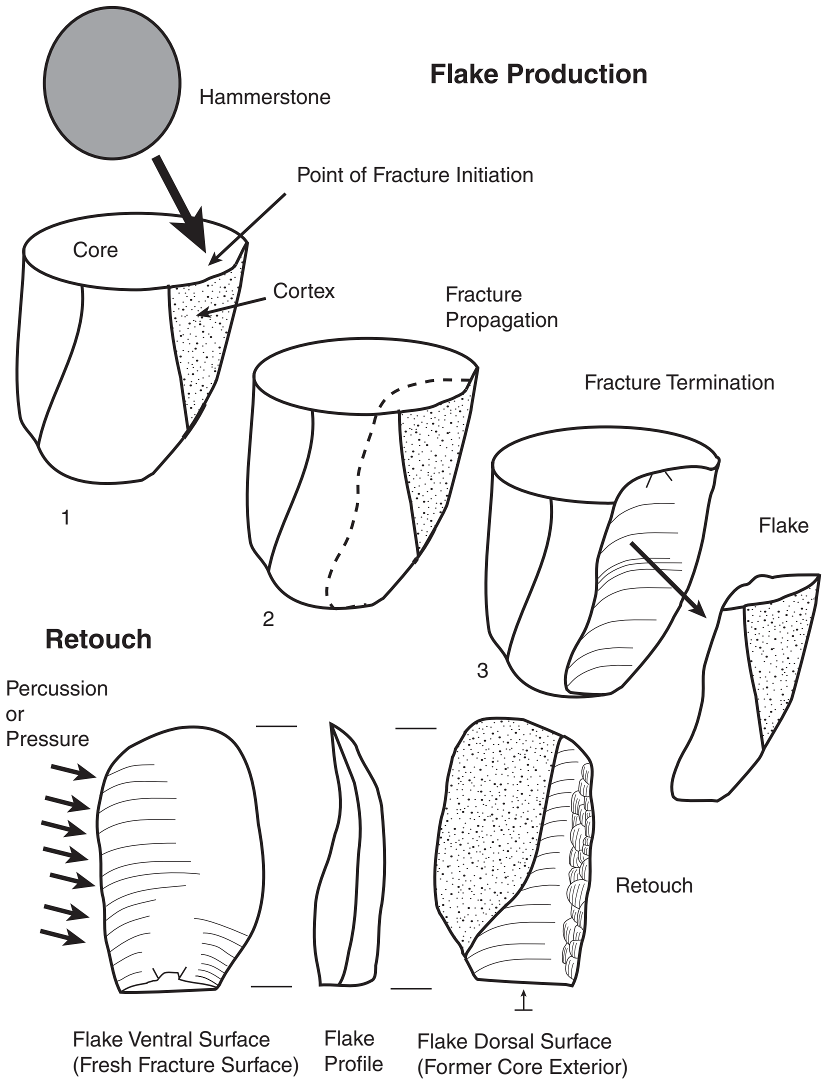


FIGURE 2.3. Knapping basics: flake production (top), retouch (bottom).

intersecting, and incompletely propagated fractures. Hammerstones and pitted stones are the most common archaeological pounded pieces. Hammerstones are usually spherical or subspherical and weigh less than 2 kg. Their most distinctive features are convex or flat concentrations of crushing and other damage resulting from their use as indenters against other rocks. Hammerstones used by modern

BOX 2.1 LITHIC ILLUSTRATION

All of the artifact illustrations in this book are redraftings of original artwork from other sources. The literary source and (where possible) original archaeological provenience of each illustrated artifact are indicated in the figure caption. To interpret these drawings, one must understand basic archaeological conventions for drawing and orienting lithic artifacts.

Conventions for drawing lithic artifacts follow most of the principles set forth in Addington (1986) (see Figure 2.4). Cortex-covered surfaces of cores and flakes are indicated by patterns of ink dots called stippling. The edges of fracture scars on core and flake surfaces are indicated by solid lines. These lines begin and end at either the edge of the artifact, another fracture scar outline, or the edge of a cortical surface.

In schematic drawings of cores and flakes, fracture directionality is indicated by placing arrows on the flake scars. Arrows with a circle at the bottom indicate a flake scar that retains the negative impression of a Hertzian cone. Simple arrows indicate that a flake scar lacks a visible point of fracture initiation, but that its propagation trajectory can be inferred from undulations and fissures. Cross-section drawings are indicated in outline and by a solid gray filling. In some cases, a hybrid profile/section drawing on which the working edge is indicated by a thick black line running across the section view is used. Lateral breaks are indicated by sets of short lines at either end of the break and extending away from the drawing in the direction that the complete artifact would have extended. Solid black filling indicates ground and polished surfaces on cores and retouched flakes. Burin removals (see main text) are indicated by arrows pointing to their point of fracture initiation.

This work differs from most conventional drawings of lithic artifacts in that it does not fill flake scars with radial lines. Most formal drawings of cores and flake points use a series of concentric radial lines to indicate the direction of fracture propagation. The convex sides of these lines bulge away from the inferred point of fracture initiation. The extent and spacing of radial lines are also used to convey an impression of shading and three-dimensionality. Radial lines are not used in this book for three reasons. First, scar directionality can usually be indicated when necessary by a single arrow. This follows Edward Tufte's (1990) guiding principle for scientific illustration: "maximum information, minimum ink." Secondly, by not cluttering artifact drawings with radial lines, the resulting images are more similar to how lithic artifacts actually appear. Finally, there is so much variability in the ways in which different artists use radial lines, not using them establishes a stylistic consistency for the illustrations in this book.

Stone tools are shown in standardized orientations in drawings and photographs. This allows lithic analysts to use a standard set of terms (i.e., dorsal, ventral, distal, proximal, medial, lateral, etc.) for analogous parts of tools. Unretouched flakes are shown with their striking platform in the proximal position (see main text). Cores are shown with their longest axis usually treated as the distal-proximal axis and the least modified of their surfaces treated as the ventral surface. Retouched tools that still retain remnants of their dorsal and ventral surfaces are oriented the same way as unretouched flakes. Retouched tools that no longer retain evidence of a striking platform are oriented with their longest morphological axis aligned disto-proximally. A few exceptions to these orientations reflect pre-existing archaeological conventions. In the illustrations for this book, the proximal part of the tool is placed in the lowermost ("6 o'clock") position.

Most artifacts are drawn in at least two views. Minimally, these usually are a plan view of the dorsal face and either a profile (side) view or a cross-section. This is done to give an impression of the artifact's three-dimensional shape. Short lines positioned at either the sides or ends of drawings indicate different views of the same object. Profile/section views are arranged around plan views so that the dorsal face remains closest to the corresponding edge of the plan view (i.e., the "American" convention) (Aprahamian 2001). Ventral flake surfaces are rarely illustrated unless they are retouched and unless they differ from the dorsal surface in some significant way. A five- or ten-centimeter scale indicates artifact size. Wherever possible in this work, illustrations of actual artifacts have been reproduced at full (100%) scale. The principal exceptions to this are for relatively large core tools.

The particular artifacts illustrated in this work were selected for their representative value. That is, a conscious effort was made to find objects that were typical for a given artifact-type and for artifacts from a wide range of contexts.

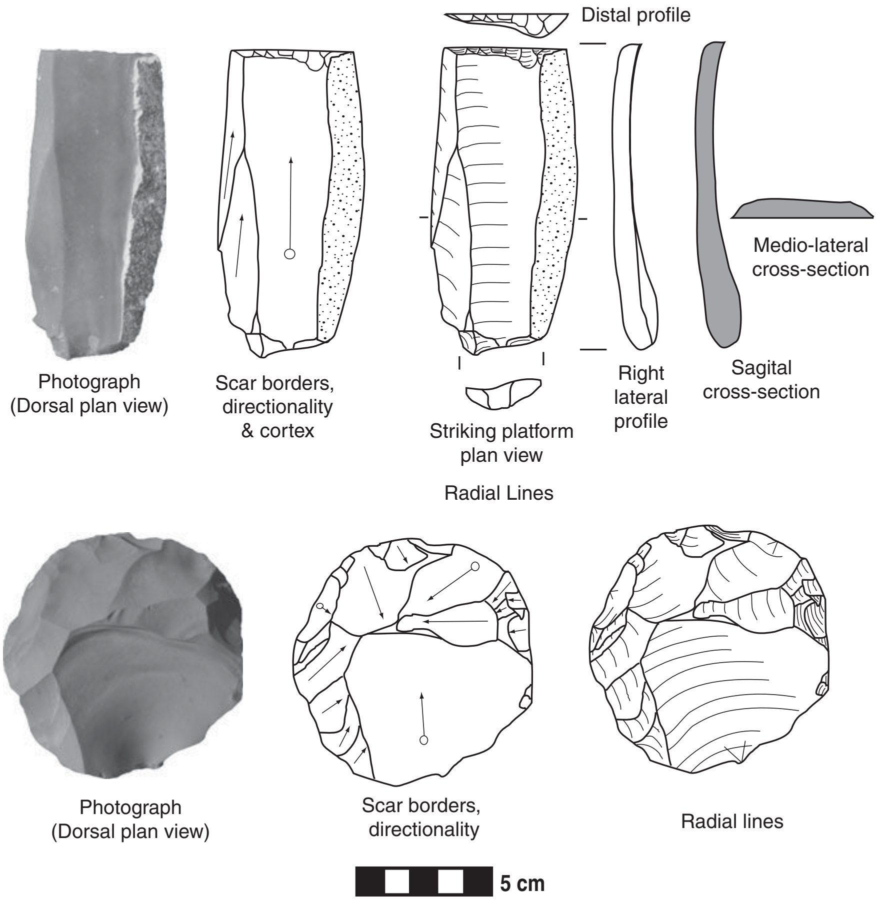


FIGURE 2.4. Conventions for illustrating flaked stone artifacts.

flintknappers often exhibit one or more discrete patches of comminution. Hammerstones used for repetitive pounding on flat surfaces (as occurs when shaping non-conchoidally fracturing rocks by percussion) often exhibit a ring of comminution running around their circumference. This damage is the result of the hammerstone being rotated axially during use. Pitted stones (also called "anvils") are usually tabular or plano-convex in cross section. Their most distinctive features are one or more sizeable concavities formed by repeated percussion and the resulting crushing damage.

Cores

Cores are rocks featuring concavities left by the flake detachment ("flake scars") above a certain size threshold (Figure 2.5). Most archaeologists require there to be at least one flake scar longer than 20 mm for an artifact to be considered a core. The working edges of most cores are defined by the presence of two intersecting surfaces, a striking platform surface and a flake-release surface. The striking platform surface is the one on which fractures are initiated. The flake-release surface is one beneath which fractures propagate. Many cores were selected for use from nodules excavated from bedrock or clasts (rocks rounded by alluvial processes). Both rocks are covered by weathered surfaces called cortex. As cores are reduced, the proportion of their surface covered by cortex decreases.

The major core types associated with particular phases of Levantine prehistory are discussed in Chapters 3 through 7. For making comparisons between cores from different periods, this book employs a core typology recently proposed by Conard and colleagues (2004). This typology recognizes three major core types (inclined, parallel, and platform), each of which has distinctive geometric and technological characteristics (Table 2.2). On inclined cores, flake-release and striking platform surfaces are interchangeable and exploited roughly equally. Parallel cores have a hierarchy of flake-release and striking platform surfaces that are exploited differently. Platform cores have flakes removed in succession from only one flake-release surface. Although originally intended for use in describing whole artifacts, the key differences in this simplified core typology are applicable to individual working edges (Figure 2.6). In theory, a single artifact could preserve worked edges exhibiting more than one of these configurations. It is also important to remember that individual cores may have shifted from one to another of these typological categories prior to being discarded.

Flakes and Flake Fragments

Flakes and flake fragments are products of conchoidal fracture. Most flakes and flake fragments are divided by the fracture plane into a

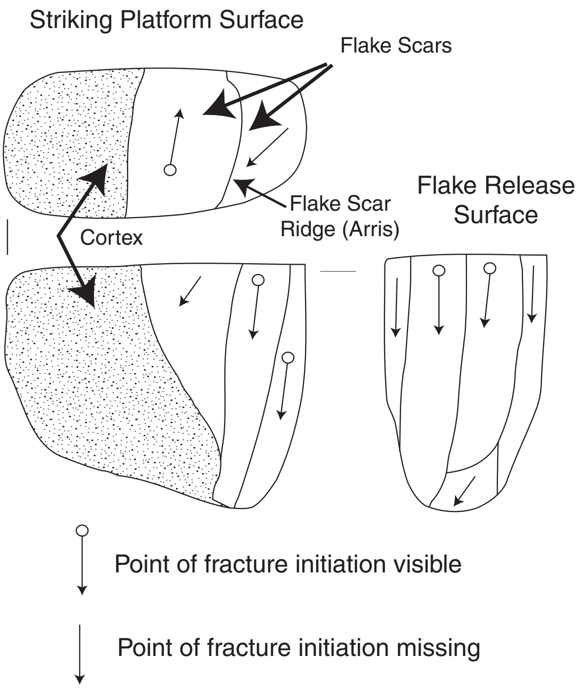


FIGURE 2.5. Core landmarks.

freshly fractured ventral surface and a dorsal surface that contains part of the former outer surface of a core (Figure 2.7). For purposes of description and orientation, the point of fracture initiation is said to be the "proximal" end of the flake. On a flake detached by Hertzian fracture initiation, this point can easily be identified by the presence of the Hertzian cone. As the fracture propagates away from its initiation point, the ventral surface becomes convex and then grows progressively flatter. The convex part of the ventral surface nearest the point of fracture initiation is called the bulb of percussion, or the bulbar eminence. Linear features, called "fissures" (or "lances"), and undulations on the ventral surface radiate away from the point of fracture initiation. If a Hertzian cone is absent, or if the striking platform is missing, lances/fissures and undulations provide additional clues to the point of fracture initiation.

The dorsal side of a flake is usually subdivided into a striking platform and the rest of the dorsal surface. The striking platform is the surface impacted by the hammerstone at the moment of fracture initiation. Its external platform angle intersects at 90° or less with the

Table 2.2. *A Simplified Core Taxonomy (After Conard et al 2004, 14, Table 1)*

Characteristic	Inclined	Parallel	Platform
Position of main flake-release surface(s).	Broad surface	Broad surface	Usually not a broad surface.
Geometry and number of flake-release surfaces.	Volume defined by two surfaces	Volume defined by two surfaces	Volume defined by more than two surfaces
Angle of removals relative to the plan of intersection defined by the worked edge and flake-release surfaces.	Roughly 45°	Less than 30°	Not applicable
Removal angle relative to the striking platform.	Not applicable	Not applicable	Greater than 45°
Orientation of removals on the main flake-release surface(s).	Converge toward the center of the removal surface(s)	Multiple possibilities	Parallel
Origin of removals.	All removals originate from the circumference defined by the intersection of the two surfaces.	All removals originate from the circumference defined by the intersection of the two surfaces.	Main removals from a well-defined striking platform surface(s).

rest of the dorsal surface opposite the point of fracture initiation. Its interior platform angle (between the striking platform and the ventral surface) is usually greater than 90°. Archaeologists usually note whether the striking platform surface is cortical, plain, dihedral, or facetted because these conditions provide insights into core preparation. As with cores, archaeologists usually note whether the dorsal side of a flake has cortex and flake scars/ridges indicating previous flake removals.

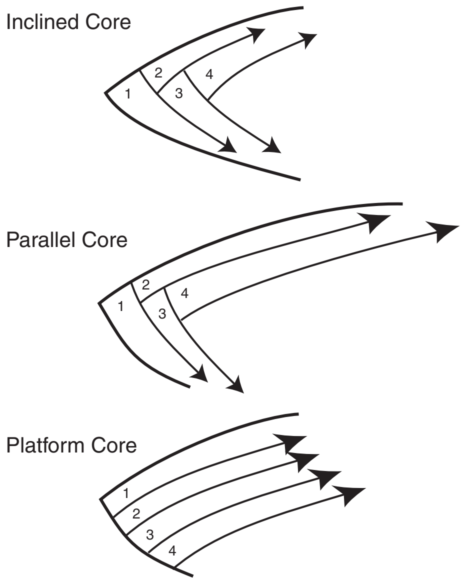


FIGURE 2.6. Working edges of major core types (inclined, parallel, platform) viewed in cross-section.

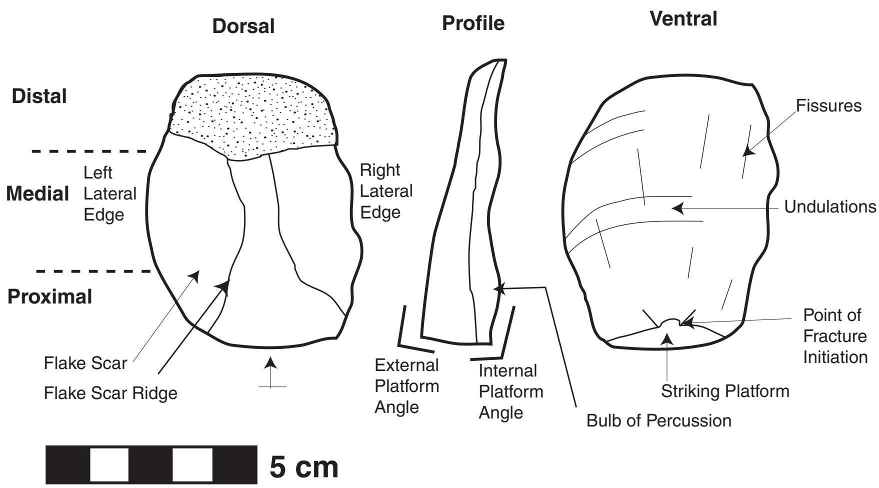


FIGURE 2.7. Flake landmarks.

Most classifications of unretouched whole flakes distinguish among cortical and non-cortical flakes, core-trimming elements, and blades (Figure 2.8). Cortical flakes are whole flakes with some remnant cortex on their dorsal surface. Greater proportions of cortical flakes and flake fragments in an archaeological lithic assemblage are thought to reflect initial stages of core reduction. Cobble fragments are cortical flakes that result from shear fracture of pebbles or cobbles.

Core-trimming elements (CTE) preserve a substantial part of a core's worked edge on parts of its dorsal surface other than in the immediate vicinity of the point of fracture initiation – that is, on the lateral or distal edges or the medial part of the dorsal surface. Some CTEs may reflect efforts to reshape, rejuvenate, or otherwise maintain a flake-release surface. Others may reflect knapping errors. CTEs are particularly valuable for research on prehistoric technological strategies because they reflect solutions to complex knapping problems (Boëda, Geneste, and Meignen 1990).

Blades are flakes whose lengths are at least twice that of their widths. "Prismatic blades" are blades with straight lateral edges and dorsal flake scar ridges aligned disto-proximally. Historically, archaeologists have viewed prismatic blade production as a complex task worthy of particular notice, but recent years have seen challenges to this consensus (Bar-Yosef and Kuhn 1999). A bladelet is a blade whose length is greater than or equal to twice its length, but not more than 50 mm long and whose maximum width is not more than12 mm.

When they are described at all, flake fragments are usually divided into proximal, medial, distal, or lateral fragments (Sullivan and Rozen 1985). Unretouched flakes and flake fragments less than 20–25 mm long and considered too small to have been used as implements while held in the hand are often described as "debris." Whole flakes less than 20–35 mm long are sometimes described as "chips."

Retouch and Retouched Tools

The terminology for describing retouch varies somewhat between different phases of Levantine prehistory, but there are some consistencies (Figure 2.9). For most researchers, retouch, to be recognized as such, must run continuously for at least a centimeter along the edge of a tool, and it must extend onto a tool surface for more than 2–3 mm.

Retouch can occur on one side of an edge (unifacial retouch) or both sides (bifacial retouch). The most common kind of retouch is unifacial retouch, which is usually located on the dorsal side of a flake. When unifacial retouch occurs on the ventral side of a flake, it is called "inverse retouch." When unifacial retouch creates a relatively sharp

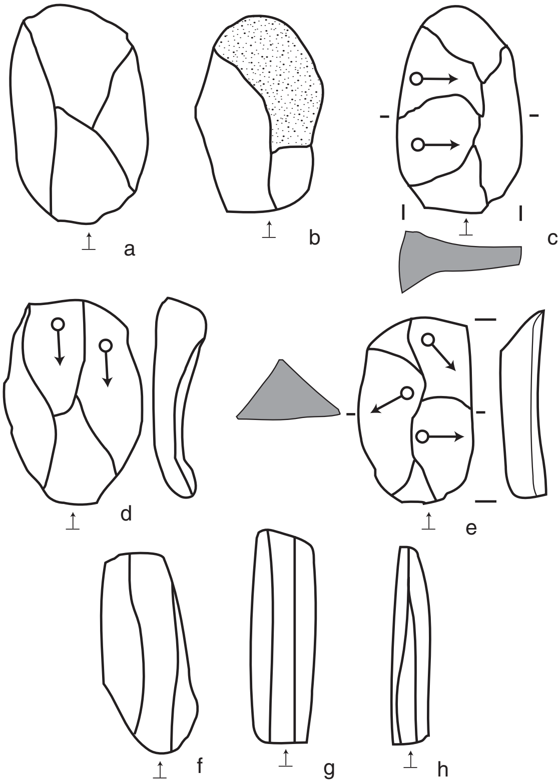


FIGURE 2.8. Major flake types. a. non-cortical flake, b. cortical flake, c. core-trimming flake-lateral, d. core-trimming flake-distal, e. core-trimming flake-medial, f. blade, g–h. prismatic blades.

edge (<70°), it is often called "scraper retouch." Backing is unifacial retouch with a steep edge-angle (>70°) located on the lateral edge of a flake. Truncation is backing applied to either the distal or the proximal end of a flake. Notching is unifacial retouch that creates a single large concavity on an edge. Denticulation is retouch formed by a series of small regularly or irregularly spaced concavities. Notching and denticulation grade into one another, with intermediate forms sometimes identified as "multiple notches." Invasive retouch is either unifacial or bifacial retouch that extends more than 10 mm onto a flake surface. Burination is a form of retouch in which a flake is struck from a point or projection along the periphery of a flake so that the resulting fracture propagates parallel to an edge and more or

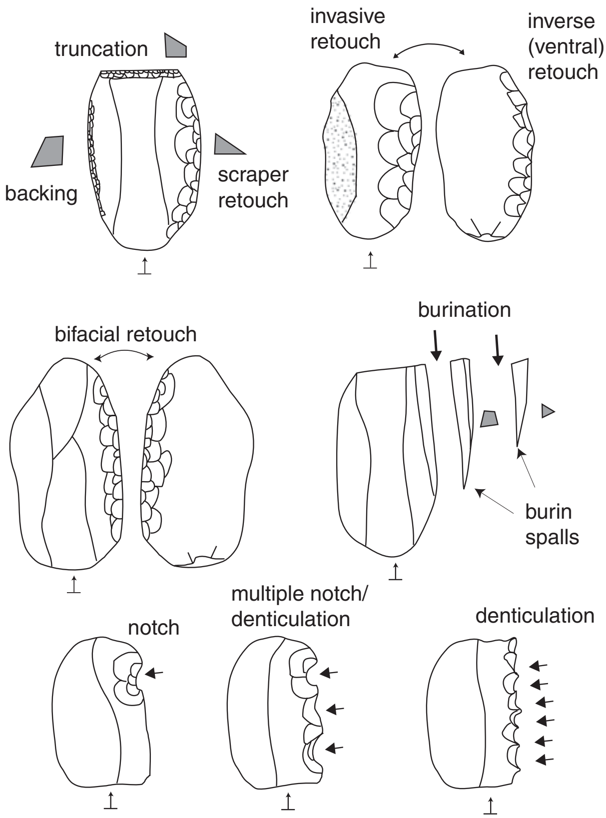


FIGURE 2.9. Retouch types.

less perpendicularly to the plane formed by the intersection of dorsal and ventral flake surfaces. The term *burin* (French for "chisel" or "engraving tool") refers to both the resulting scar pattern and the tool itself. The narrow elongated flake detached by this form of retouch is called a burin spall.

Retouched tools are flakes that have been modified by one or more kinds of retouch (Figure 2.10.a–j). Scrapers are flakes with at least one unifacially retouched edge that is less than 70° in profile. Truncations are flakes with a steeply retouched edge at either their distal or proximal end. Backed knives are flakes with steep unifacial retouch on their lateral edge. Awls are flakes with two relatively short retouched edges that converge to a point. Points are bilaterally symmetrical triangular

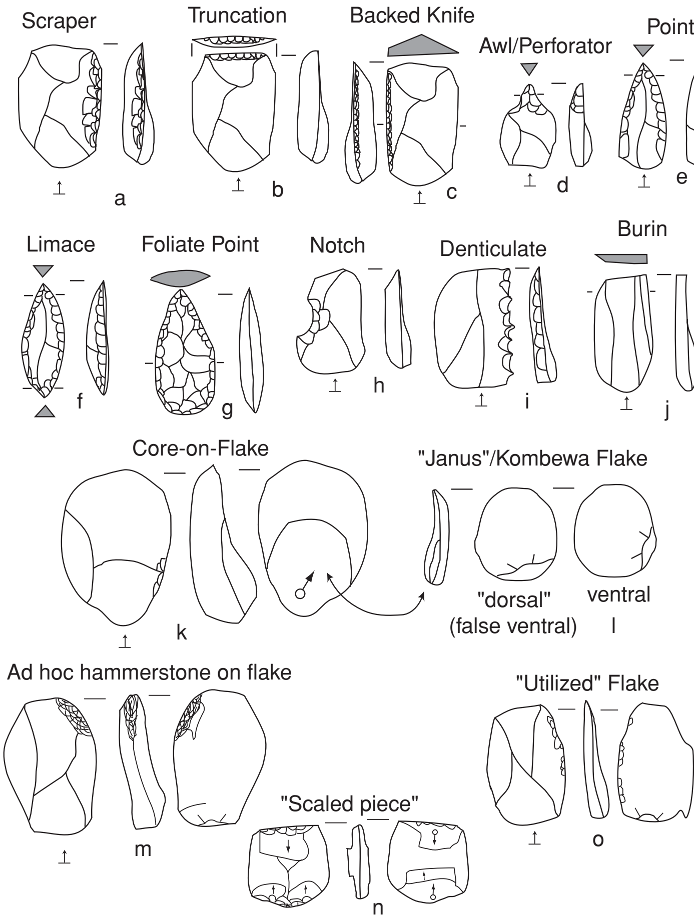


FIGURE 2.10. Retouched tool types and problematical pieces. a. scraper, b. truncation, c. backed knife, d. awl/perforator, e. point, f. limace, g. foliate point, h. notch, i. denticulate, j. burin, k. core-on-flake, l. "Janus"/Kombewa flake, m. ad hoc hammerstone on flake, n. "scaled piece," o. "utilized" flake.

flakes with retouched lateral edges that converge at their distal end. Foliate points (also known as foliate bifaces) are relatively thin pointed tools covered wholly or partly by invasive retouch. *Limaces* (French for "slug") are flakes with steeply retouched lateral edges that converge at both distal and lateral ends. Burins are flakes with one or more burin scars on them. Notches are flakes with one or more notched edges. Denticulates are flakes with one or more denticulated edges.

Composite tools are retouched tools that combine the properties of more than one of these retouched tool types (e.g., scraper-perforator, burin-awl).

Problematical Artifacts

Some artifacts fit into more than one of the four major categories of lithic artifacts described in the previous subsection (see Figure 2.10.k–o).

Core-tools are cores on which retouch has been applied to one or more edges. The key factor in differentiating these artifacts from cores is whether the retouch is focused on a discrete part of the tool edge. If not, then these fractures are usually interpreted as incidental damage accumulated in the course of flake production.

Cores-on-flakes are flakes that have had one or more relatively large scars detached from them, reflecting their use as cores. In principle, cores-on-flakes could be treated as cores, flake fragments, or retouched flakes. Most analysts treat them as cores. When the ventral surface of a flake was used as a flake-release surface, the resulting core and flake (which can appear to have two ventral faces) is called either a "Janus flake/core" (after the Roman god with two faces) or a "Kombewa flake" after a village in Kenya where early examples of these artifacts were observed (Leakey 1936).

Ad hoc hammerstones are cores, flakes, flake fragments, and retouched tools that exhibit crushing, fractures, and other damage from use as a hammerstone. These artifacts are not usually classified as hammerstones, but instead as cores, flakes, flake fragments, or retouched tools incidentally damaged by use.

Scaled pieces (*outils ecaillées* or *piéces esquillées* in French) are flake fragments with one or more concentrations of invasive flake scars on dorsal and/or ventral surfaces. Scaled pieces are often treated as retouched tools, but similar kinds of damage can result from flake production (e.g., from using bipolar percussion on a flake or flake fragment) and from use (from using a stone flake as a wedge to split wood). They are increasingly viewed as byproducts of mechanical damage during tool use rather than as a deliberately shaped tool.

Utilized flakes preserve microfracturing along their edge that is thought to be too small and/or unpatterned to be retouch but large enough to indicate use-related damage. Such edge-damage usually extends no more than between 2–3 mm onto the dorsal or ventral side of an edge. Earlier descriptions of lithic assemblages often list utilized flakes as a distinct artifact-type. This practice is less common in more recent studies, reflecting a growing recognition that trampling, soil compaction, and other factors unrelated to tool use can create similar edge damage.

Groundstone Tools

Groundstone tools – artifacts shaped by carving and abrasion – often used alternation with percussion. The principal categories of groundstone tools are pulverizing equipment (grinding slabs, querns, handstones, mortars, pestles, etc.) used to process seeds, mineral pigments and other substances, celts (core-tools with polished working edges), stone vessels, and a variety of other perforated and incised objects. (Groundstone tools are rare in all but the latest Paleolithic and Neolithic contexts and are discussed more fully in Chapters 6 and 7.)

Higher-Order Groupings of Lithic Artifacts

Higher-order groupings of stone tools consist of a hierarchy of technological and typological characteristics, artifact-types, assemblage-groups/industries, and industrial complexes.

Groups of lithic artifacts that share similar morphological characteristics are called artifact-types. The attributes and variables archaeologists use to define artifact-types are usually divided into technological and typological characteristics. Technological characteristics are those related to choices of techniques and methods used in tool production. For example, the overall size of an artifact, the degree to which it has cortex, and its retouch reflect the choices of the raw material and the extent to which it has been modified. Typological characteristics reflect the imposition of arbitrary shape. Whether the tool is round, square, or triangular in plan view; whether retouch is unifacial or bifacial; and whether there are any patterns in the alignment of scars on the surfaces of the tool reflect choices toolmakers made among a range of functionally equivalent design options. Technological variables are generally thought to reflect differences in human adaptation, whereas typological variables are thought to reflect cultural differences among prehistoric toolmakers. This technology/typology dichotomy, however, is a false one. Technological choices (such as whether to use a particular tool or to retouch it) can reflect cultural differences, and variation in knapping techniques can influence tool morphology.

Lithic assemblages are groups of stone tools found in the same archaeological context. When more than one assemblage share similar inventories of artifact-types, they are often described as assemblage-groups or "industries" (Clarke 1978). Industries from more than one major geographic region that differ typologically but share similar technological characteristics are called "industrial complexes."

Prehistorians use the term "culture" for lithic assemblage groups very sparingly. It is more common in Epipaleolithic and Neolithic periods when either (1) patterns of lithic typological variation are paralleled in other kinds of archaeological evidence, such as ceramics, architecture, bone tools, or personal adornments; or (2) variation in these other lines of evidence carry greater analytical weight than the lithic evidence. Archaeologists also use the term "tradition" for chronologically sequential assemblage-groups between which they perceive strong typological similarities. The terms "culture" and "tradition" imply that archaeological assemblage-groups correspond closely to social divisions among prehistoric humans. The terms "industry" and "industrial complex" have no such implications; they merely indicate similarities in prehistoric human adaptation related to stone tool technology.

Artifact-types and industries are often given proper names, usually derived from the site at which they were first identified. For example, the terms "Mousterian point" and "Mousterian Industry" are both derived from the French rockshelter, Le Moustier, where examples of Mousterian tools were first identified. Less commonly, the name for an artifact or an assemblage-group may be taken from a region in which the artifact or industry occurs, such as "Nubian core" or "Levantine Mousterian Industry."

Prehistorians often use type-lists and a variety of technological and typological indices to quantify inter-assemblage lithic variability. Type-lists differ between time periods. Appendix 1 provides type-lists for each of the major prehistoric periods discussed in this book. Most indices of lithic variability are simple ratios of one or more groups of artifact-types divided by some larger number of artifacts in an excavated lithic assemblage. These indices vary from period to period, and there are significant differences among researchers both in how these indices are computed and in how heavily they are weighted in debates about inter-assemblage variability. There are also indices based on metric variation among artifacts, also varying in computation and analytical use.

Ratio-scale measurements increase the quality of archaeological data and improve the kinds of hypotheses about prehistoric behavioral variability one can test with this evidence. Appendix 2 provides a guide to common measurements made on major groups of artifacts.

III. INTERPRETIVE CONCEPTS IN LITHIC ANALYSIS

Archaeologists have developed numerous theoretical concepts for interpreting variation among stone tools (Andrefsky 2005, Inizan et al. 1999, Odell 2004). Before delving into the details of the Levantine lithic evidence, it is important to define and discuss the most important of these concepts.

Stone artifacts come to us as static entities, but they are products of dynamic behavioral processes. Linking static lithics to dynamic behavior requires one to correlate patterns of variation in the lithic record to variability in behavioral strategies. Strategies are solutions to a specific set of problems determined by the interaction of costs, benefits, and risks on evolutionary actors (Krebs and Davies 1991, Pianka 1988). Modeling strategic variation involves hypotheses about the changing relationship between cost and benefit over time. The three most fundamental of these relationships are optimization (maximizing benefits per unit of cost), satisficing (obtaining minimally necessary benefits per unit of cost), and intensification (increasing costs in return for unchanging or declining benefits). The precise currencies of costs and benefits involved in various dimensions of lithic variability and how to measure them are much debated. Time, energy, and risk are obvious variables (Torrence 1989, 2001), as they are for nearly all behavior, but other factors specific to stone tool technology involve utility (potential for continued use), versatility (potential for multiple uses), and portability (costs associated with transporting lithic artifacts).

Lithic artifacts pose some unique obstacles for strategic modeling. Unlike food or reproductive opportunities (the usual currencies of behavioral and evolutionary ecological models), the benefits of lithic technology are durable and transferable. That is, once a stone tool is made, it can be used by individuals other than its original author for years, decades, centuries, or millennia. Thus, the forms in which stone tools come to us from the archaeological record, both as an individual artifact and as artifacts in complex patterns of association, can reflect a complex overlay of individual strategic choices. In this, stone tools are like palimpsests, Medieval parchment manuscripts erased and written-over many times.

Human behavior involving stone tools can be broken down into four major problems, each calling for different strategic solutions. These are raw material procurement, tool production, tool use, and discard/recycling. Many of the interpretive concepts archaeologists use to understand these behaviors are problematical, either because they dichotomize a complex continuum of behavioral variability or because they uncritically project what are likely recent aspects of technological variability into prehistoric contexts.

Raw Material Procurement

In writing about the procurement of lithic raw materials, archaeologists usually distinguish between local materials (those available within a day's walk of a site), and exotic materials available from further afield. Strategies for procuring lithic raw materials are discussed in terms of embedded and direct procurement (Binford 1982, Kuhn 1995). In embedded procurement, small quantities of raw materials are gathered in the course of daily foraging activities. In direct procurement, lithic materials are gathered in bulk from specific sources and transported to sites where they are modified and used. Archaeologists often equate local lithic materials with embedded procurement and exotic lithic materials with direct procurement. Reality can complicate these dichotomies. It is reasonable to assume that transporting lithic materials over great distances increased selective pressure for collecting high-quality materials. Consequently, archaeologists often assume that high-quality rocks represented in small quantities in a lithic assemblage are exotic. Although this might be correct, one needs to be alert to the possibility that they are local materials available only in small quantities. Similarly, embedded and direct procurement do not exhaust the range of strategies humans use to acquire lithic raw materials. Predictable patterns of residential site location and stable social relationships create incentives for more complex trade and exchange patterns, such as emissary trade and down-the-line exchanges. The Neolithic and later phases of Southwest Asian prehistory offer abundant evidence for such complex exchange strategies (Cann, Dixon, and Renfrew 1969).

In recent literature, archaeologists often draw a distinction between strategies for provisioning places and provisioning people with tools and raw materials (Kuhn 1993). Provisioning places involves transporting artifacts and lithic materials to habitation sites. The benefits of this strategy are contingent, delayed, and transferable. They accrue with prolonged and recurrent site occupations and persons other than those transporting materials can benefit from them. Provisioning people involves the creation and transport of personal gear. Provisioning people yields immediate benefits, and they are to a limited degree transferable, but they also entail costs, such as designing tools with high potential utility and functionally versatile designs. Archaeologists sometimes link particular types of stone tools to one or another of these strategies, but the actual relationship is almost certainly more complex. In large part, this is because strategic costs and benefits are continuously variable. An artifact that might make an appropriate choice as transported personal gear in one context might be prohibitively costly under a different set of circumstances. For example, while it might make sense to transport a two-kilogram core of high quality rock into a region impoverished in flint, this would be a poor strategic choice for a residential movement into a region where flint is underfoot nearly everywhere. Further complicating matters, traditional archaeological lithic systematics rarely distinguish artifacts on the basis of their size or mass, variables that are clearly germane to assessing their potential utility. Similarly, it is rare to see lithic raw materials described to greater precision than major rock types, such as flint/chert, limestone, basalt, or obsidian. There is, however, tremendous variation within each of these rock types, which affects their suitability for stone tool production.

Tool Production

Stone tools with useful cutting edges can be made in a matter of seconds or carefully knapped over the course of hours or longer periods.

Archaeologists use the term "expedient" for the former tool-production strategy and "curated" for the latter. "Curation" can be confusing because it conflates optimization and intensification (Shott 1996). Unnecessarily prolonged effort in tool production is a kind of intensification. Knapping in the service of recovering more potential utility from a given mass of stone is a form of optimization. It can be difficult to distinguish between the effects of intensification and optimization in the lithic record, because one can curate a stone tool by carefully shaping it to improve its functional efficiency, by resharpening it, by modifying it for novel uses, by transporting it, or by some combination of these activities.

In thinking about stone tool production, it is also crucially important to be alert to projecting modern-day habits of thought onto prehistory. For example, proponents of operational chain approaches to lithic analysis often dichotomize stone tool production in terms of *façonnage* (shaping a core-tool) and *débitage* (the production of flakes intended for use as tools) (see Inizan et al. 1999). No matter how well this dichotomy describes the thought processes of modern-day flintknappers and lithic analysts, it is a false dichotomy. The flakes detached in the course of shaping a core tool remain potentially useful tools (with or without subsequent modification) and the cores produced by flake production retain potentially useful cutting edges and surfaces.

That the stone tools we find are overwhelmingly ones made by adults in the service of their various economic and ecological adaptations is probably another backward projection of a recent (and largely Western) categorical distinction between adult work and child's play (Shea 2006a). Children are involved in tool production in many parts of the world today, and even where they are not, children learn many technical skills by imitation. Although it may be possible to differentiate the lithic output of children and other novice knappers in more complex lithic production sequences (Pigeot 1990), its presence may remain undetectable in simpler aspects of stone tool production.

Similarly, and although it is the case that ethnographic stone tool production is done mainly by men, the notion that prehistoric stone tool production was a gender-specific activity seems improbable (Gero 1991). Again, whether or not we can credibly detect gendered structuring of prehistoric lithic variation remains an open question.

Much of the "culture history" of the Stone Age reflects perceived differences in stone tool designs and production techniques. Using these variables to construct quasi-historical entities, such as stone tool industries or archaeological cultures, potentially underestimates prehistoric toolmakers versatility and behavioral variability. Ethnographic stone-tool-makers vary their production techniques widely in response to seasonal differences in demands for tools (Thomson 1939) and other factors, including shifts in their cultural landscape (see Shackley 2000). Many modern-day flintknappers can shift between widely differing modes of stone tool production (Whittaker 2004). Behavioral variability is a hallmark of hominin adaptation, particularly *Homo sapiens* adaptation (Potts 1998, Shea 2011b, 2011c). It is only logical to expect that such behavioral variability influenced variation in the archaeological lithic record from the earliest times onward.

Tool Use

When archaeologists speak of stone tool use, or function, they do so at differing levels of specificity. At the most basic level archaeologists often differentiate between "tools" (cores and retouched artifacts) and "waste" (unretouched flakes and flake fragments). Numerous ethnographic studies, however, describe the use of unretouched flakes (Holdaway and Douglas 2012). Experimental studies verify their utility (Crabtree and Davis 1968, Jones 1980), and microwear analysis report evidence for their use in the past (Keeley 1980). This tool/waste dichotomy projects conventions of industrial-scale mass production back into the Stone Age.

At a further level of specificity, archaeologists speak of stone tool use as involving either extractive activities (food acquisition and other forms of energy capture) or maintenance activities (tool production and repair) (Binford and Binford 1969). They may also write of specialized versus multipurpose tools (Odell 1981). These categorical distinctions are also false dichotomies. Butchering an animal can both acquire food (meat and fat) and tool materials (bone, hide, or sinew). A tool designed for one narrow purpose can be co-opted into different purposes as circumstances require. For example, metal arrowheads used by Southwest African hunter-gatherers are also used as drills, knives, chisels, and woodworking tools (Wiessner 1983).

The expectation of strong form/function correlations among stone tools is a further obstacle to the development of in archaeological theory about stone tool use (Odell 2001). Many of the names archaeologists have given to specific artifact-types (such as "scraper," "burin," "projectile point," and the like) imply specific and consistent modes of use. This expectation makes sense in terms of present-day tool use. Most archaeologists live in sedentary societies and work in environments bristling with specialized tools. In more mobile ethnographic societies, tool designs place a greater emphasis on portability and functional versatility. Prior to agriculture, all hominin and most human societies likely practiced land-use strategies involving high residential mobility. For this reason, functional variability was likely the rule, and not the exception, for most of prehistory. Among residentially mobile groups, the main factor that constrains functional variability in stone tool use is hafting, which removes portions of tool edge from possible use (Keeley 1982).

Sedentism may have reduced stone tool functional variability (Kelly 1992, Wallace and Shea 2006). Among sedentary groups, or ones with low residential mobility, fixed residential sites encourage the production of heavy specialized tools, such as seed-grinding equipment, because they are likely to be re-used at those sites. If stable residential sites were provisioned with large quantities of flaked stone, the wide range of stone tools' available sizes and shapes ought to have encouraged prospective tool users to select artifacts whose sizes, shapes, and edge configurations were better fits for particular tasks – leading to stronger form/function correlations.

Discard/Recycling

Archaeologists have long been aware that reuse and recycling influence lithic variability, particularly with variability among retouched tools and cores (Cahen, Keeley, and Van Noten 1979, Dibble 1995, Frison 1969). Nevertheless, there persists in the archaeological literature a kind of "finished artifact fallacy," an assumption that the forms in which stone tools are preserved in the archaeological record reflect specific designs held in the minds of their makers (Davidson and Noble 1993). In contrast, re-use, recycling, and allied phenomena affect nearly every dimension of recent human material culture (Schiffer 1987). All but indestructible stone tools persist on exposed surfaces and in the vicinity of habitation sites, available for use, for more prolonged periods. If anything, one might expect the effects of recycling/reuse to be even more pronounced among stone tools than in other dimensions of material culture.

Social and Cultural Aspects of Lithic Variation

In addition to these more pedestrian aspects of lithic technology, archaeologists have developed interpretive concepts linked to more esoteric aspects of social identity. Because the technological choices recent humans make are conditioned by factors relating to their social context, such as learned patterns of behavior and the social use of symbols, it is reasonable to expect similar factors to be at work in the prehistoric lithic record.

Style is a crucial concept in this regard. In its original formulation, style referred to cultural differences in technological choices, but the concept has since been parsed into iconological and isochrestic styles (Sackett 1982). Iconological style refers to information overtly incorporated into artifact designs for the purpose of broadcasting a specific message. Isochrestic style refers to patterned choices among functionally equivalent designs arising from learned patterns of behavior. They are not intended to actively broadcast a symbolic message, but they can provide clues about cultural similarities and differences among the people making those choices. Stone tools have the potential for both iconological and isochrestic stylistic variability. Conspicuous use of visually distinct exotic raw material might be a plausibly iconological aspect of stylistic variability. Backing the edge of a flake bifacially, as opposed to unifacially, might be a plausibly isochrestic style variant. Hypotheses that one or another stone tool is a stylistic marker of some prehistoric social entity have to be weighed against the simplicity of the technology involved and the improbability that identical patterns of variability could arise independently of one another. These probabilities are intuitively lower in earlier stages of tool production (in raw material choice and tool fabrication), and higher in later stages (in tool use and discard/recycling).

Archaeologists read many things into the lithic record – chronicles of evolutionary progress, landscapes of cultural variation, and patterns of behavioral variability. At its core, however, the lithic record reflects variation in the habits of stone tool production and use. Archaeological lithic analysis seeks to reconstruct those habits and to explain their variability.

3

THE LOWER PALEOLITHIC

I. INTRODUCTION

The Lower Paleolithic Period (>2.5–0.3 Ma) witnessed the origins and diversification of the Genus Homo, as well as early hominin geographic expansion beyond Africa and into Eurasia. These events played out over the course of a transition from a relatively warm and stable Pliocene climate to a colder and more variable Pleistocene climate. Around 0.9 Ma, the world began to experience glacial/interglacial cycles about every 120,000 years, a process that continues to the present day (Burroughs 2005).

Lower Paleolithic Hominin Evolution

The principal hominins associated with Lower Paleolithic assemblages from about 1.8 Ma onward, *Homo ergaster*, *H. erectus*, and *H. heidelbergensis* differ from earlier hominins (*H. habilis* and various australopithecines) in having larger bodies, more fully terrestrial locomotor adaptations, and encephalization (brain enlargement) (Klein 2009). Larger brains and a reduction in gut size suggest regular access to higher-quality food sources (Aiello and Wells 2002), such as meat and fat from animal sources and underground plant storage organs. Evidence for the use of fire at sites dating to at least 0.8 Ma (Goren-Inbar et al. 2004) hints at cooking practices and more complex social and technological strategies than those associated with living non-human primates (Wrangham 2009). The stone tools left behind by Lower Paleolithic hominins differ from those made by living apes most obviously by including tools with sharp cutting edges and by retouch, indicating the deliberate imposition of shape on lithic raw materials (Toth and Schick 2009). All these developments are generally viewed as reflecting a trend toward more complex and variable patterns of hominin behavior (Potts 1996).

Levantine Evidence

In the Levant, the onset of Middle Pleistocene glacial cycles led to alternations between cold, dry conditions and a landscape dominated by steppe vegetation and warmer humid conditions during which woodlands expanded (Horowitz 1988). These cyclical changes in climate likely led to repeated turnovers in Levantine animal populations and dispersals of fauna (including hominins) from adjacent regions into the Levant (Tchernov 1998).

In the Levant, the oldest non-controversially dated archaeological site is Ubeidiya (Israel, ca. 1.4 Ma), but hominin fossils dating to 1.8 Ma at Dmanisi (Georgia) suggest an earlier hominin presence in western Asia. All in all, there are around two dozen geochronometrically dated Levantine Lower Paleolithic archaeological sites (Table 3.1 and Figure 3.1). Perhaps two dozen better documented occurrences can be assigned to this period from artifact typology or regional geological-stratigraphic correlations (Bar-Yosef 1994, Goren-Inbar 1995, Muhesen 1998, Ronen 2006, Shea 2008). The end of the Lower Paleolithic Period in the Levant is currently dated to ca. 0.245 Ma (Porat et al. 2002). Levantine prehistorians do not formally subdivide the Lower Paleolithic Period, but doing so in terms of geological periods reveals a somewhat richer record for the Middle Pleistocene (0.7–0.13 Ma) than for the Early Pleistocene (2.5–0.7 Ma).

Lower Paleolithic Lithic References

Published descriptions of Levantine Lower Paleolithic assemblages use several different typologies. In the northern Levant, many researchers use the typology developed for Europe by Bordes (1961, Debénath and Dibble 1994). In the southern Levant, archaeologists often use a typology formulated by M. Leakey (1971) for East Africa. Here, Lower Paleolithic stone tools are discussed in terms of four major groupings of

Table 3.1. *Geochronology of the Levantine Lower Paleolithic*

Site and Level	Ma	K-Ar	U-S	OSL	TL/ESR	Pmag	Biost	Dating Reference
MIDDLE PLEISTOCENE								
Berekhat Ram	>0.2	+						Goren-Inbar (1985)
Kaltepe Deresi 3, Levels II–XII	>0.2	+						Slimak et al. (2008)
Tabun Level Ea-Eb/Units XI–X	>0.2		+		+			Rink et al. (2004)
Umm Qatafa Cave Levels D–E	>0.2						+	Tchernov (1996), Porat et al. (2002)
Zuttiyeh Cave	>0.2		+					Schwarcz et al. (1980)
Yabrud Shelter I, Levels 11–18	>0.3				+			Porat et al. (2002)
Holon D	0.2–0.3			+	+			Chazan and Horwitz (2007)
Qesem Cave	>0.2–0.4		+					Barkai et al. (2003)
Karaïn Cave Units A–E (Levels 33–61)	0.3–0.4				+			Otte et al. (1998b)
Revadim	>0.3-<0.7					+	+	Marder et al. (1999)
Tabun Cave Level Ec-F/Units XII–XIII	>0.4							Grün and Stringer (2000), Mercier and Valladas (2003)
Maayan Barukh	0.4		+					Schwarcz et al. (1980)
Latamne, Latamne Formation	0.5–0.7						+	Sanlaville et al. (1993)
Evron Quarry Unit 4	>0.7					+		Ron et al. (2003)
EARLY PLEISTOCENE								
Gesher Benot Ya'acov	0.7–0.8							Goren-Inbar et al. (2000)
Dursunlu	0.9					+		Güleç et al. (1999)
Bizat Ruhama Level C1	0.9–1.0	+				+		Zaidner et al. (2003)
Ubeidiya Li, Fi Formations	1.4					+	+	Tchernov (1987)
Erq el-Ahmar	1.8–2.0	+				+	+	Tchernov (1999)
Yiron Level 3 (Gravel)	>2.4	+						Ronen (1991)

KEY: Ma = millions of years ago, K-Ar = radiopotassium, U-S = Uranium series, OSL = optically-stimulated luminence, TL/ESR = thermoluminescence and/or electron spin resonance, Pmag = inferred from paleomagnetic stratigraphy, Biost = Inferred from biostratigraphy.
Note: This table lists only those sites dated by geological or paleontological evidence. It excludes contexts dated solely by the typological characteristics of lithic evidence or by stratigraphic correlations between sites and regional sequences.

artifacts: pebble cores, large cutting tools, retouched tools, and pounded pieces.

II. PEBBLE CORE TECHNOLOGY

Pebble cores are subspherical, hemispherical, or roughly cuboid artifacts that have been shaped by varying amounts of hard-hammer percussion. Striking platform and flake-release surfaces are interchangeable on such cores. Thus, most would be considered either inclined or parallel cores in the Conard et al. (2004) core typology. Many pebble-cores were originally rounded clasts (pebbles or cobbles). Residual abraded cortical surfaces preserved on the core are evidence of this clastic origin.

Major Pebble-Cores Types

The principal forms of pebble cores include choppers, discoids, and polyhedrons, but each of these categories varies widely, in some cases cross-cutting the distinctions between inclined, parallel, and platform cores. The following definitions of pebble-cores follow M. Leakey (1971) (see Figures 3.2–3.3 and CUP Website Figures 1–3).

A chopper is a pebble core that has had flakes removed from at least 25–75 percent of its circumference. A significant portion of the remaining core circumference is unmodified. If flakes were removed from one face of an edge, the core is a unifacial chopper. If flakes were removed from both faces of the same edge, it is a bifacial chopper. Choppers whose edges are asymmetrical (one flat, the other convex) are sometimes designated as core-scrapers, or (if relatively large) as heavy-duty scrapers. Leakey (1971) recognized several additional subtypes of choppers (side, end, two-edged, pointed, and chisel-edged), but there is much variation in the degree to which these more specific morphological tool types are recognized by lithic analysts today.

A discoid is a pebble core that has had flakes removed from its entire circumference, or very nearly so (more than three quarters). Most discoids are more or less symmetrical and either biconvex or plano-convex in cross section. If there are remnant cortical surfaces on a discoid, they are usually at the center of either the dorsal or ventral surface, and framed by the distal ends of flake scars originating from the core

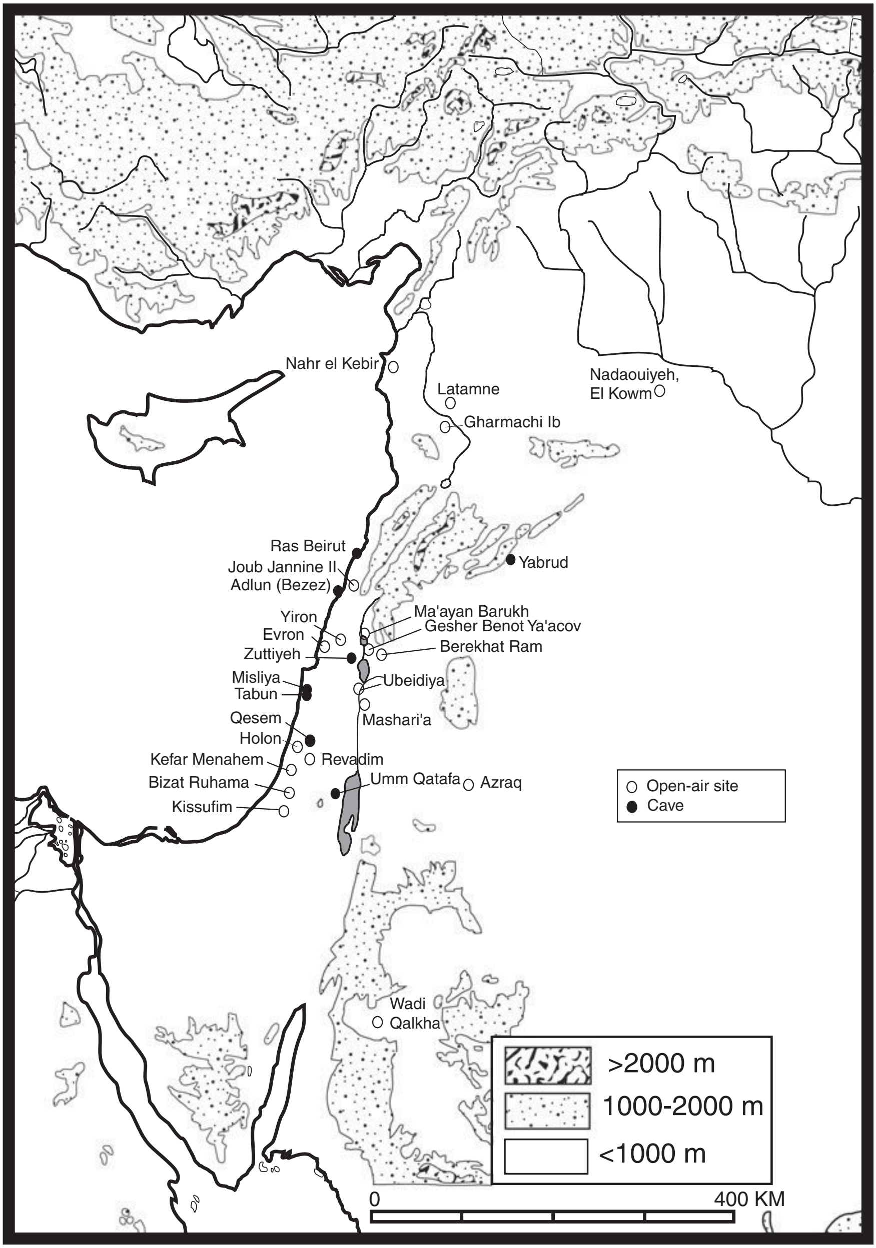


FIGURE 3.1. Map showing important Lower Paleolithic sites.

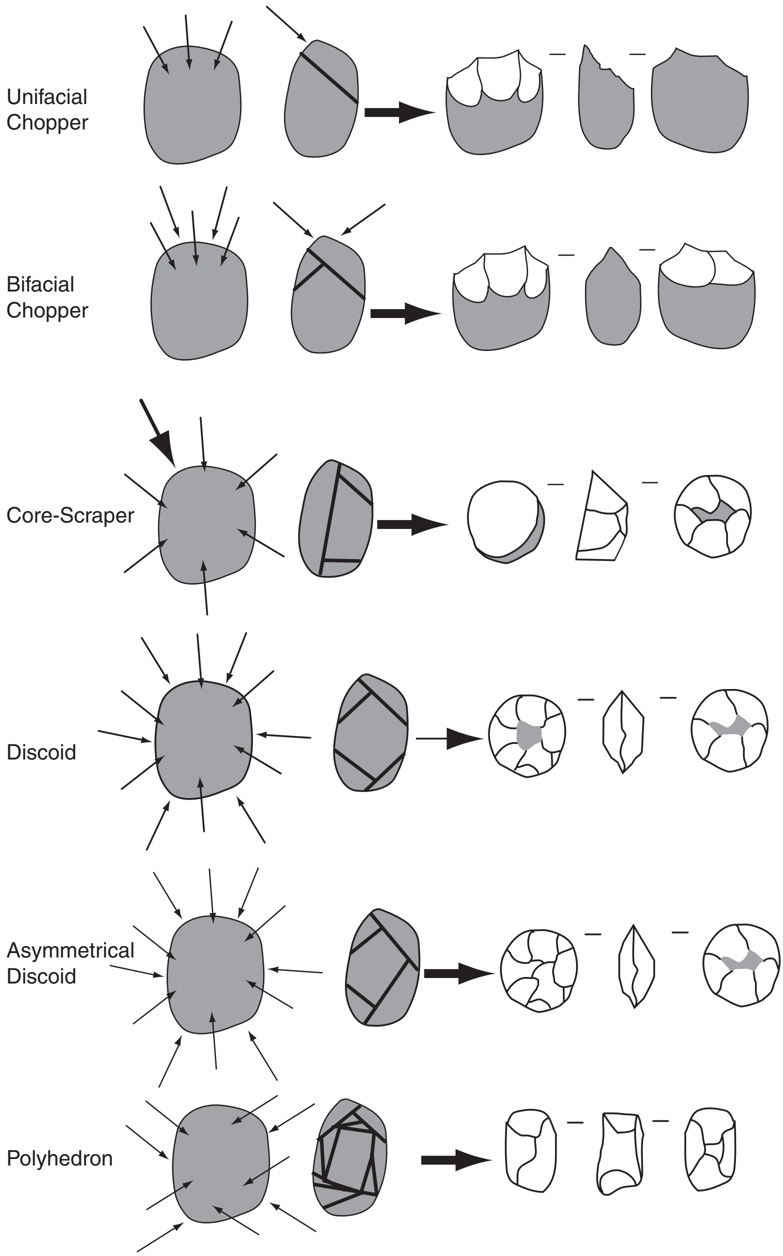


FIGURE 3.2. Major categories of Lower Paleolithic pebble-cores.

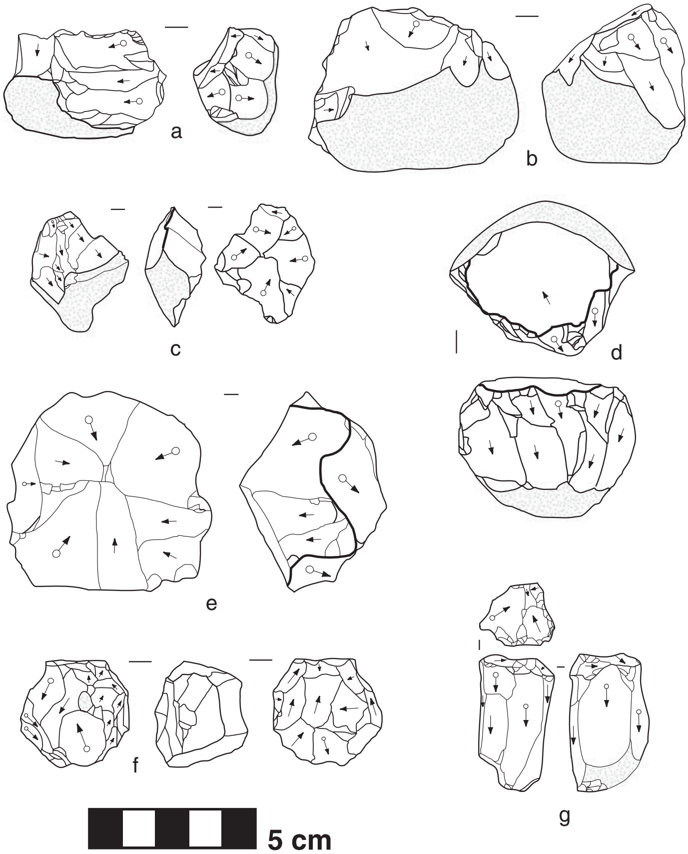


FIGURE 3.3. Lower Paleolithic pebble-cores: a–b. choppers, c, e. discoids, d. core-scraper, f. polyhedron, g. prismatic blade core. *Sources:* Ubeidiya (a–f), Qesem Cave (g). Redrawn after Bar-Yosef and Goren-Inbar (1993), Barkai et al. (2006).

periphery. Most discoids comfortably fit the definition of "inclined" cores, but some exhibit a hierarchy of flaking surfaces and could be viewed as "parallel" cores (Conard et al. 2004). Such asymmetrical discoids, are more extensively flaked on one side than the other (i.e., they are parallel cores rather than inclined cores).

A polyhedron is a blocky core (presumably originally a pebble or an angular rock fragment) with more than one discrete worked edge. Cores whose worked edge bifurcates at some point along the core periphery are also considered polyhedrons.

Some pebble-cores from Levantine Lower Paleolithic contexts are considered blade cores or prismatic blade cores (parallel cores in the Conard et al. 2004 typology). Most of these blade cores differ from those from later contexts in that their laminar aspect reflects a naturally elongated nodule shape and not purposeful knapping to create an elongated shape (Barkai et al. 2009). Similar blade cores occur in African and other Eurasian Lower Paleolithic contexts (Bar-Yosef and Kuhn 1999).

Flakes Produced by Pebble Core Technology

Flakes produced by pebble-core reduction are relatively short and thick (see CUP Website Figure 4). Many have a residual cortical surface on their dorsal side. When the flake is relatively elongated and the dorsal cortex runs the length of one lateral edge, the flake is sometimes classified as "naturally backed knife."

Most analyses of Levantine Lower Paleolithic flake variation use the measurements in Appendix 2 and classify flakes in terms of the broad categories discussed in Chapter 2 (e.g., cortical versus noncortical flakes, flake fragments, and so on).

Explaining Variation among Pebble-Cores

Hypotheses about variation among pebble-cores have focused mainly on function and curation. Many pebble-cores preserve macroscopic edge damage that suggests they were used as cutting or chopping tools. Experiments confirm their utility in such tasks (Jones 1994, Tactikos 2005, Toth 1997), but there is little or no microwear or residue evidence that they were used systematically for these purposes. Nor is there evidence that different kinds of pebble-core types differed from one another functionally. Choppers-discoids-polyhedrons can be arranged into a series of increasingly modified forms whose relative frequencies in archaeological assemblages may reflect greater or lesser amounts of curation (Potts 1988; see CUP Website Figure 5). However, at least one experimental study (Toth 1997) shows that the initial shape of pebbles and cobbles exerts a powerful influence on the shape of the resulting pebble-cores.

Pebble Cores and Ecofacts

Natural processes can imitate the byproducts of pebble-core technology. Fluvial or colluvial transport of rocks with conchoidal fracture properties can create objects that, selectively gathered and presented, can be mistaken for artifacts by even expert paleoanthropologists (Grayson 1986). Archaeologists have developed many criteria for distinguishing artifacts from naturally fractured rock (Barnes 1939, Gillespie, Tupakka, and Cluney 2004, Patterson 1983, Peacock 1991); but, these criteria retain a strong subjective component (see Table 3.2).

III. LARGE CUTTING TOOLS

Large cutting tools (LCTs) are large symmetrical artifacts (usually >10 cm long) found in Lower Paleolithic assemblages after 1.6 Ma. They are more common in African, European, and South and West Asian assemblages and less common in contexts from northern and eastern Asia. Many LCTs are flaked on both dorsal and ventral faces, leading archaeologists to refer to LCTs collectively as "bifaces." LCTs with unifacial retouch, however, occur as well. Treating LCTs as retouched tools, rather than as cores, is a somewhat arbitrary decision. LCTs share with pebble-cores the interchangeability of striking platform and flake-release surfaces, and most fit the definition of inclined cores. But many LCTs also feature carefully flaked tips and lateral edges, suggesting purposeful use-related design.

Major Types of Large Cutting Tools

The most commonly identified types of LCTs include picks, handaxes, cleavers, protobifaces, and massive scrapers (Figures 3.4 and 3.5 and CUP Website Figures 6–11).

A pick is a large (>10cm long) elongated bifacial core with a thick distal tip formed at the conjunction of two slightly concave lateral edges (Figure 3.4.a). This tip can be either rectangular or plano-convex in cross section, and either lenticular or plano-convex in profile. Double-pointed picks feature two such points at opposite ends of the same tool. In some Southwest Asian Lower Paleolithic

Table 3.2. *Criteria for Identifying Human Agency in the Production of Stone Artifact Assemblages (Shea 2010)*

Rank and Inference	Cores/Flaked Pieces	Flakes/Detached Pieces	Other Considerations for Assessing Human Origin of Artifact Assemblage
Human origin probable, natural origin improbable	Large sample size (n = >30) Extensive and symmetrical scarring showing imposition of symmetry and asymmetry on different axes of core (e.g., picks, handaxes) Noncortical cores predominate More than one negative flake scar on majority of cores	Large sample size (n >100) Ventral radial lines common Bulbar scars (eraillures common) Surfaces mostly unweathered Predominantly non-cortical flakes More than one dorsal flake scar >1cm long on most flakes Majority of flakes have dorsal flake scars aligned parallel one another Negative dorsal bulb scars on 59% or more flakes	Cut marks assessed by a zooarchaeologist using microscopy Flaked stone artifacts burnt by fire Refitting sets of artifacts in close proximity Low energy depositional context Majority of sample recovered from controlled excavation
Equivocal, no way to objectively decide between human vs. natural origin	Small sample size (n = <5) Non-cortical cores account for less than 50% of sample More than one negative flake scar on minority of cores	Moderate sample size (n >10, <100) Even proportions of flakes with bulbar scars (eraillures) Even mix of weathered, unweathered surfaces	Claimed cut marks/linear scratches on bone Majority of sample selected judgmentally from surface

		Even proportions of cortical/non-cortical flakes More than one dorsal flake scar >1cm long on less than 50% of flakes Fewer than 30% of flakes have dorsal flake scars aligned parallel one another Negative dorsal bulb scar on 30–50% of flakes	
Natural origin not refutable	One or fewer artifacts Non-cortical cores predominate Few/no cores with negative flake scars	Small sample size (n = <10) Ventral radial lines rare Bulbar scars (eraillures) rare Surfaces heavily weathered Predominantly cortical flakes More than one dorsal flake scar >1cm long on less than 20% of flakes Negative dorsal bulb scar on <10% of flakes	Collection unavailable for study (for any reason) Majority of sample selected judgmentally from surface. Stratigraphic provenience unclear/unconfirmable

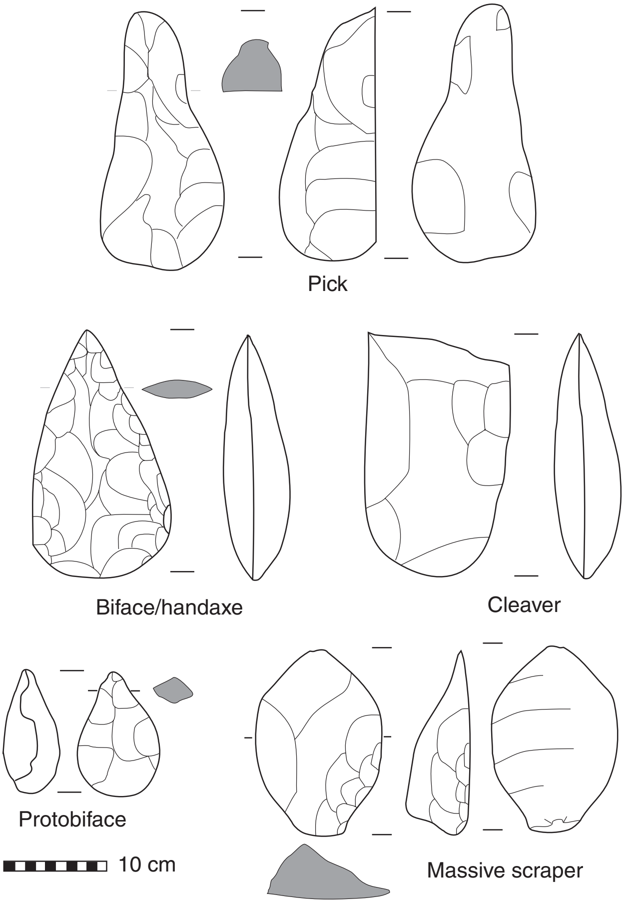


FIGURE 3.4. Major categories of Lower Paleolithic large cutting tools (LCTs).

assemblages (e.g., 'Ubeidiya, Latamne), the distal ends of picks have been retouched on three or even four sides. Such picks are called trihedral picks (alternatively "tridhedrals") or quadrihedral picks.

A handaxe is a large bifacial core whose relatively straight lateral edges converge to a sharp symmetrical distal point (Figure 3.4.b). Handaxes/bifaces are typically symmetrical in cross section near their tip. The proximal end is either rounded or angular, and there is often a remnant cortical surface in this area. There are many named sub-types of handaxes; ovates and Micoquian handaxes are two of the most common in Levantine contexts. Ovates are large symmetrical bifaces

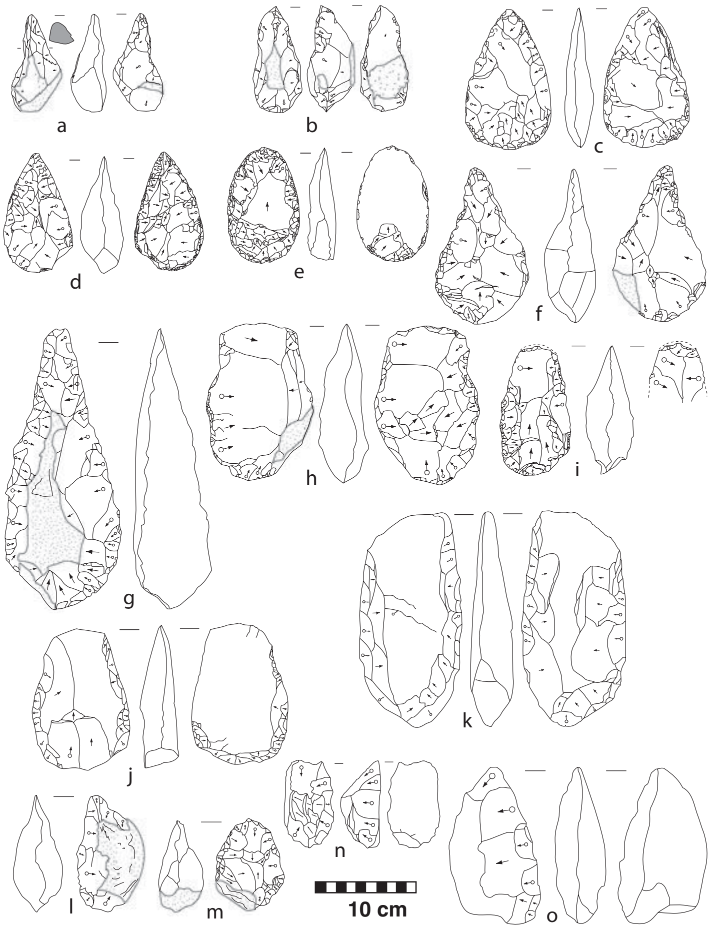


FIGURE 3.5. Large Cutting Tools: a–b. Picks, c–g. bifaces/handaxes, h–i. core cleavers, j–k. flake cleavers, l–m. protobifaces, n–o. massive scrapers. *Sources:* Ubeidiya (a), Latamne (b, g, l), Maayan Barukh (c–f, h, m), Azraq Lion Spring (i), Gesher Benot Yaacov (j–k, n–o). Redrawn after Bar-Yosef and Goren-Inbar (1993: 64), Clark (1967: 32), Copeland (1989b), Goren-Inbar et al. (1991), Goren-Inbar and Saragusti (1996), Goren-Inbar et al. (2008: 706–707), Stekelis and Gilead (1966).

whose lateral edges are convex. Their distal ends may be either pointed or rounded. "Micoquian handaxes" (after La Micoque, France) have a sharp and elongated tip formed by straight or mildly convex lateral edges. (The term "handaxe" remains popular, but many researchers use the term "biface" because it has no overt functional implications.

This terminological shift creates problems of its own, because not all handaxes are bifacially worked.)

A cleaver is an elongated bifacial core or flake with an acute, broad edge running more or less transversely to the long axis at the distal end (Figure 3.4.c). This distal edge is usually unretouched. Increasingly, Levantine prehistorians distinguish between cleavers that retain evidence of their origin as large flakes (flake cleavers) and those that do not (core cleavers).

A protobiface is a relatively small (<10 cm) pointed core (Figures 3.4.d). Often, the proximal end of a protobiface is blunt and has remnant cortex, but this is not a universal feature. M. Leakey thought protobifaces were precursors to handaxes, but they are now known to be contemporary with these artifacts. The two most popular current views of protobifaces see them either as elongated forms of discoids (Harris and Isaac 1997) or as heavily resharpened/curated LCTs (Jones 1994). These hypotheses are not mutually exclusive, and both may capture some key sources of variation among protobifaces.

Massive scrapers (also known as "heavy-duty scrapers," "core-scrapers," or "large scrapers") are flakes, usually longer than 10 cm, that have been unifacially retouched, often steeply, along one or more edges (Figures 3.4.e). These artifacts differ from other scrapers mainly in their size, and thus they appear to be more closely related to LCT production than to pebble-core reduction.

Typological approaches to LCT morphological variability arbitrarily partition complex patterns of morphological and technological variability. Bordes (1961) and other typologists (Bosinski 1967, Debénath and Dibble 1994) employ a much longer list of LCT types further subdivided on the basis of tip symmetry, thickness, and other variables (Table 3.3 and Figure 3.6). There is much variation in the degree to which these additional LCT types are recognized in published descriptions of Lower Paleolithic assemblages.

Byproducts of LCT Production

LCT production creates several distinctive kinds of fracture products, including biface-thinning flakes, overshot flakes, tip-removal/breakage flakes, and tranchet flakes (Figures 3.7 and 3.8)

Biface thinning flakes are flakes struck from a bifacially knapped LCT that propagate deeply across the flake-release surface (often past

Table 3.3. *Bordes's (1961:71–93) Terminology for Bifaces*

No.	English Name (French Name) and Description	Flat/Thick
1	Lanceolate biface (*biface lancéolé*) – thick and elongated biface with broad, thick ("globular") base and elongated straight or moderately convex lateral edges.	Thick
2	Ficron biface (*ficron*) – as No. 1, but with lateral edges that are jagged or sinuous in profile.	Thick
3	Micoquian biface (*biface Micoquien*) – as No. 1, but with concave edges and a sharp tip.	Thick
4	Triangular biface (*biface triangulaire*) – flat biface roughly isosceles plan shape, with straight retouched base and straight or moderately convex lateral edges.	Flat
5	Elongated triangular biface (*biface triangulaire allongée*) – as No. 4, but with moderately concave lateral edges. Elongation index value is greater than 1.5.	Flat
6	Cordiform biface (*biface cordiforme*) – flat biface with rounded retouched base and convex edges that converge to a point or a rounded tip.	Flat
7	Elongated cordiform biface (*biface cordiforme allongée*) – as No. 6 but with an elongation index value is greater than 1.5.	Flat
8	Subcordiform biface (*biface subcordiforme*) – as No. 6, but relatively short and retaining cortex on base.	Flat
9	Ovate biface (*ovate*) –flat biface with rounded base and elongated convex edges that converge to sharp point. Elongation index values between 1.3–1.6.	Flat
10	Amygdaloid biface (*biface amygdaloide* or "almond-shaped") – thick biface with thick, often cortical base, straight to slightly convex edges.	Thick
11	Discoidal biface (*discoide*) – essentially a flat discoidal core with moderate elongation (<1.3).	Flat
12	Limand (*limande* or elongated oval) – as No. 9, but more elongated (>1.6).	Flat
13	Biface cleaver (*hachereau bifaciale*) – cleaver whose broad distal edge is formed by the removal of a tranchet flake aligned perpendicular to the long axis of the tool.	Thick or Flat
14	Cleaver on flake (*hachereau sur éclat*) – cleaver whose broad distal edge is a remnant unretouched edge of a large flake.	Thick or Flat
15	Lageniform/bottle-shaped biface (*biface lagéniforme*) – as No. 1, but with straight lateral edges and a rounded, rather than pointed tip.	Thick
16	Naviform biface (*biface naviforme* or "arch-shaped") – flat biface with convex lateral edge and points at both distal and proximal ends. Elongation index values >1/5.	Flat
17	Abbevillian biface (*biface Abbevillien*) – thick biface with sinuous or "s-shaped" edge shaped by a series of isolated and alternating flake scars. Extensive remnant cortex is present. Tip is thick, often trihedral.	Thick
	Lozenge-shaped biface (*biface lozengique*) – biface with straight or convex edges, but an irregular shape in plan view.	Thick or Flat
	Core-shaped biface (*biface nucléiforme*) – biface shaped like a discoidal core, but with a straight "functional" cutting edge on part of its circumference.	Thick or Flat
	Miscellaneous (*divers*) – bifaces that do not conform to one of the other named types.	Thick or Flat
	Partial biface (*biface partiel*) – biface on which only a small portion of the circumference has been flaked.	Thick or Flat

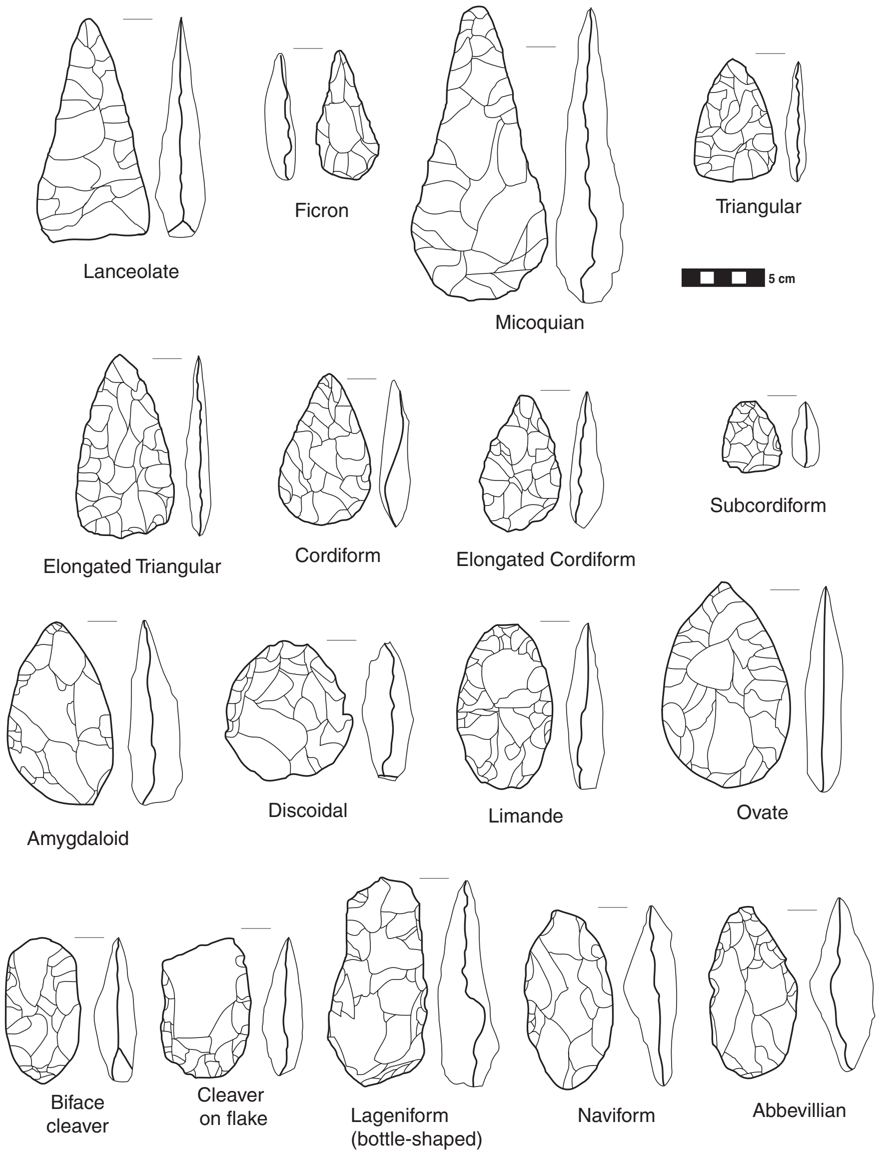


FIGURE 3.6. Major biface types recognized in Bordes's typology. All modified after illustrations in Bordes (1961).

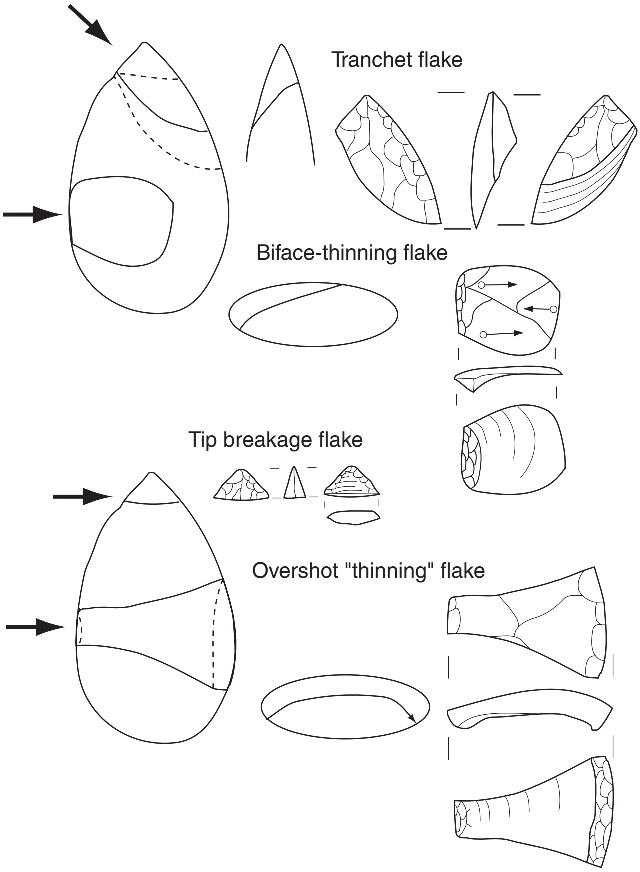


FIGURE 3.7. Major categories of debitage related to production and curation of bifacial LCTs.

the midpoint of that surface). Although the name implies knapping to impose shape (*façonnage*), detaching such flakes can produce relatively large flakes with minimal loss of core circumference, thus preserving its potential working edge. Bifacial thinning flakes usually have facetted striking platforms. The internal platform angle is relatively high and the external platform angle is relatively acute. Soft-hammer percussion is particularly effective in biface thinning, and if this technique was used, there may be no Hertzian cone on the striking platform (Sharon and Goren-Inbar 1999). Overshot flakes are biface thinning flakes that have propagated across the entire flake-release surface then plunged in the opposite direction, removing part of the opposite edge. Tip-removal/breakage flakes preserve the tip of a LCT on their dorsal surface. Some of these artifacts may result from use-related breakage of the narrow (and thus structurally weak) biface tip. Others may reflect resharpening of the LCT tip with an obliquely directed fracture. This latter strategy is most clearly apparent in tranchet flakes. Tranchet flakes are initiated on the lateral edge of a biface near the tip, and they propagate either perpendicularly or obliquely to the biface's long axis. The resulting flake preserves part of the biface's distal edge. The resulting scar creates a flat surface and a broad, sharp cutting edge at the tip of the biface.

Giant Core Technology and Lower Paleolithic Levallois Technology

Some LCTs from Levantine Lower Paleolithic assemblages were knapped from large flakes (>10 cm long) struck from even larger cores (also known as "giant cores") (see Madsen and Goren-Inbar 2004, Sharon 2007; CUP Website Figure 12). Some of the large flakes struck from these cores were further modified into LCTs. The best documented examples of such large cores and flakes are from Gesher Benot Ya'acov in Israel (Sharon 2008). These cores and flakes were made from boulders of fine-grained basalt that outcrop near the site. Similar approaches to the production of large flakes from boulder cores are known from a wide range of African and Asian contexts, where they are called "Tachengit/Tabalbalat cores" and "Victoria West cores" (Sharon 2009). Because the scarring patterns on some of these cores indicate that reduction stopped after a large, invasive, and symmetrical flake was detached, Eurasian prehistorians often call them "proto-Levallois" cores.

Explaining Variation among LCTS

LCTs (specifically handaxes) were among the first stone artifacts recognized as evidence for human Pleistocene antiquity in the mid-nineteenth century. Consequently, there is a long history of archaeological speculation about their variability. Raw material variability has been shown to influence morphological variability among regional types of LCTs in Africa (Jones 1994), Europe (Villa 1983), and the Levant (Sharon 2008). At the global level, however, there does not seem to

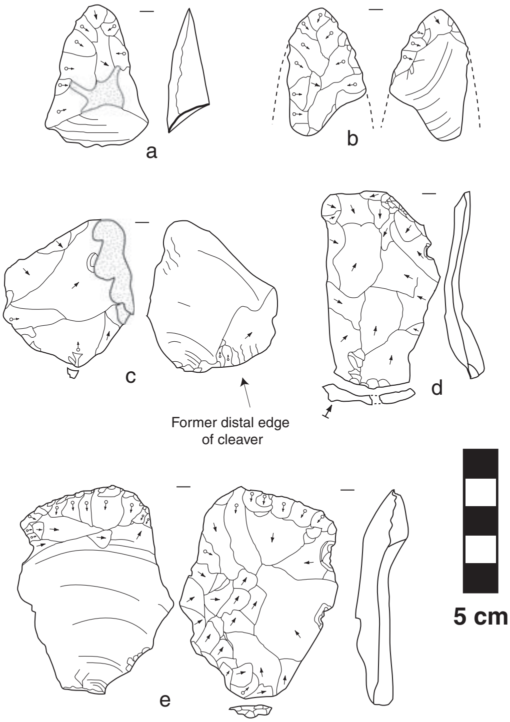


FIGURE 3.8. Biface resharpening flakes. a. tip of pointed biface, b. biface tip detached by tranchet flake, c. cleaver tip detached by tranchet flake, d. biface thinning flake, e. overshot/plunging flake. *Sources:* Azraq Al-Bayda Dune (a), Yabrud 1 (b), Azraq Lion Spring (c–e). Redrawn after Copeland (1989a; 1989b).

be any one-to-one correspondence between particular raw materials and specific LCT types. Experimenters have found LCTs especially effective in butchery, but they are remarkably versatile tools (Jones 1980, 1994; Machin, Hosfield, and Mithen 2007, Shea 2007b, Toth 1987). The hypothesis that they were projectile weapons thrown like a discus (O'Brien 1981) has been challenged by experimental research (Whittaker and McCall 2001) and is no longer widely supported. Instead, LCT variation shows the greatest consistency in preserving sharp-edges on a symmetrical tool (Lycett 2008). The hypothesis about LCT variability that requires the fewest assumptions is that LCTs served both as cores and as heavy-duty cutting tools, and that variation in curation accounts for many of the morphological differences among named LCT types (McPherron 2006; (CUP Website Figure 13).

IV. RETOUCHED FLAKE TOOLS

Retouched flake tools from Levantine Lower Paleolithic contexts include the common forms enumerated in Chapter 2. Few lithic analysts divide truncations, backed pieces, notches, denticulates, or awls into distinct sub-types on the basis of the number and arrangement of retouched edges. Most make a number of distinctions among unifacially retouched flakes or scrapers.

Lower Paleolithic retouched scrapers are usually subdivided into either single, double, or convergent scrapers. Further subdivisions of these types consider the shape of the retouched edge(s) in plan view and other variables (Figure 3.9). Single scrapers feature one continuous retouched edge. Among single scrapers, endscrapers are flakes that are retouched at the distal end of their technological long axis. When this edge is relatively broad (i.e., equal to the maximum width of the tool) and aligned perpendicularly to the morphological long axis of the tool, the artifact is called a transverse scraper. Sidescrapers have been retouched on one of their lateral edges. Double scrapers have been retouched on both (non-converging) lateral edges. Convergent scrapers have retouched edges that meet at a point. Symmetrically convergent scrapers with denticulated lateral edges are called Tayac points. Although called "points," Tayac points are very thick in cross section and most researchers view them as a kind of scraper. Many of these retouched flake tools grade into one another in ways that may reflect either variation in initial flake shape, variable amounts of resharpening, or both (see CUP Website Figure 14). Nevertheless, several Levantine Lower Paleolithic retouched tool categories seem to comprise technologically and typologically distinct artifact-types.

Yabrudian scrapers take their name from Yabrud Cave. Yabrudian scrapers are not a monomorphic artifact-type, but are instead from a group of large, transverse, canted, and convergent scrapers made on relatively thick flakes and featuring deeply invasive unifacial or bifacial retouch. This retouch is called "Quina" and "demi-Quina" retouch, after the French site of La Quina. Yabrudian scrapers are found mainly in later Lower Paleolithic contexts.

Truncated-facetted pieces are flakes that have been truncated on one or more edges. Some of these artifacts also feature small, invasive flake removals propagating 2–3 cm onto either the tool's dorsal (or

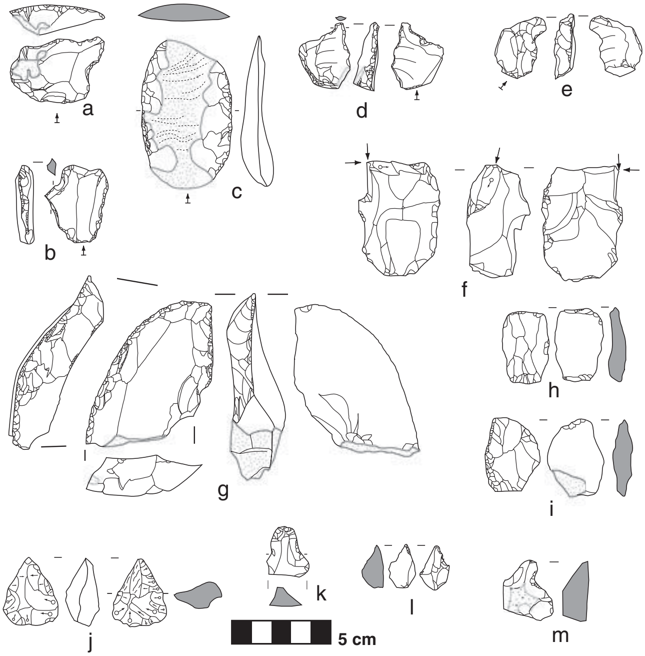


FIGURE 3.9. Lower Paleolithic retouched flake tools. a. transverse scraper, b. double side-scraper, c. notch, d. awl, e. denticulate/multiple notch, f. burin, g. transverse scraper, h–i. truncated-facetted pieces (aka "Nahr Ibrahim truncations"), j–m. micro-tools (j. biface, k. endscraper, l. awl/denticulate, m. notch). *Sources:* Adlun, Bezez Cave (a–b, f–g), Ubeidiya (c–d, e), Holon (h–i), Bizat Ruhama (j–m). Redrawn after Bar-Yosef and Goren-Inbar (1993), Chazan and Kolska-Horwitz (2007), Copeland (1983b), Zaidner (2003).

less often, ventral) surface. These latter flake scars are smaller than most Levantine prehistorians consider the lower limit for plausible tools. Nevertheless, some researchers classify them as cores-on-flakes (Goren-Inbar 1988, Hovers 2007). Truncated-facetted pieces were first identified in Levantine Middle Paleolithic assemblages from Nahr Ibrahim in Lebanon (Solecki and Solecki 1970) and Jerf el-Ajla in Syria (Schroeder 2007). Older literature refers to them as Nahr Ibrahim cores/truncations or Jerf Ajla cores.

Zaidner and colleagues (2003) recently introduced the term "micro-tools," for a broad category of small (<3 cm long) retouched flake tools with one or more steeply-retouched edges. (Such Lower Paleolithic micro-tools should not to be confused with "microliths" from Upper Paleolithic and Epipaleolithic contexts.) As a taxon, "micro-tools" combines various scraper types as well as awls, notches, and composite tools. Thus, they are not a single tool type, but rather a broad class of artifacts defined by their small size. The presence of micro-tools in more than a few Lower Paleolithic assemblages (e.g., Bizat Ruhama, Ubeidiya) suggests Levantine prehistorians may have been underestimating the lower size range of tools that were used by Pleistocene hominins.

Explaining Variation among Retouched Flake Tools

There does not appear to be any strong association between particular retouched tool-types and flake technology. Most of the major named retouched tool types occur on flakes from pebble-core reduction and flakes from LCT production. Micro-tools from Ubeidiya and Bizat Ruhama occur in contexts where the kinds of lithic raw materials of which they are made are available as small clasts. Although some of the names given to Lower Paleolithic retouched tools imply functional differences, there is no evidence for consistent form-function correlations among these retouched flake tools. Zaidner et al. (2003) have proposed that Lower Paleolithic micro-tools might have been hafted tools, but there is as yet no conclusive microwear or residue evidence to support this theory.

V. POUNDED PIECES

Lower Paleolithic assemblages contain hammerstones and pitted stones as well as subspheroids and spheroids (Figure 3.10).

A subspheroid is a rock, generally spherical in shape or with a subangular profile. Its surface bears traces of numerous sub-conchoidal fractures whose ridges have been flattened by percussion and abrasion. A spheroid is a spherical stone whose surface is covered by pitting, comminution, and other evidence of pounding against another hard object. Most spheroids and subspheroids are smaller than 15 cm in diameter and weigh less than 1 kg, but larger examples are known (Willoughby 1985). In the Levant, spheroids and subspheroids were usually made of raw materials with poor conchoidal fracture properties, such as limestone or quartzite (Goren-Inbar 1995).

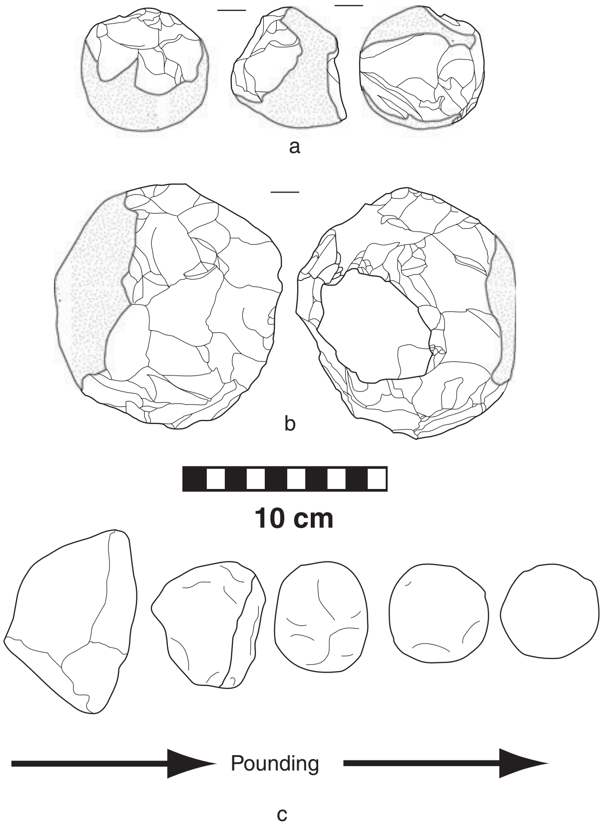


FIGURE 3.10. Pounded pieces (a–b), and pounded pieces reduction model (c). *Source:* Ubeidiya. Redrawn after Bar-Yosef and Goren-Inbar (1993).

Schick and Toth (1994) have proposed that spheroids and some subspheroids are angular fragments of rock co-opted for use as hammerstones. The angular projections of these former cores became pitted and rounded. As their users rotated the hammerstone, this damage would become more extensive, rounding points and projections. Eventually, these curated hammerstones would resemble subspheroids and, after more prolonged usage, spheroids. Sahnouni (1997) has proposed an alternative hypothesis – that many subspheroids are "failed cores." He notes that many subspheroids and spheroids are made of rocks with poor conchoidal fracture qualities (quartz, quartzite, limestone), and he suggests these suboptimal cores were abandoned when they became too rounded to yield flakes.

Louis Leakey (1960), among others, argued that spheroids might have been used as "bola stones." Bola stones are ethnographic hunting weapons consisting of sets of stones individually wrapped in leather pouches that are linked together at the ends of ropes and thrown at fleeing animal prey. (Contrary to popular myth, bolas disable prey by knocking them off pace while running, not by wrapping themselves around an animal's legs.) This mode of use is plausible for smaller spheroids/subspheroids, but dubious for specimens weighing more than 1–2 kg. It has not yet been shown that the crushing and pitting on the surfaces of spheroids and subspheroids would have had any effect on these artifacts' performance as bola stones. Clark (1955) proposed that smaller examples of these tools might have been mounted on the end of sticks in a leather pouch and used as mace-heads. That many spheroids and subspheroids have been found near water has suggested that they may have been used to process plant foods that grow near the edges of lakes and streams (Binford 1989). Nearly all Lower Paleolithic sites, however, were located close to either lakes or streams, and thus the association between pounded pieces and aquatic plant foods is no stronger than for any other kind of Lower Paleolithic artifact. Analysis of damage and residues on pitted stones from Lower Paleolithic contexts at Gesher Benot Ya'acov suggests these tools were used to crush seeds and to crack nuts (Goren-Inbar et al. 2002).

VI. LEVANTINE LOWER PALEOLITHIC INDUSTRIES

The four major named Levantine Lower Paleolithic industries include Pebble Core Assemblages, the Acheulian, the Tayacian, and the Acheulo-Yabrudian. Table 3.4 lists representative assemblages assigned to these industries.

Pebble Core Assemblages

As in much of Africa and Eurasia, the earliest claimed Levantine archaeological assemblages are Pebble Core Assemblages (PCAs). These assemblages consist of pebble cores and associated flakes with few retouched tools. Some refer to these assemblages as "Oldowan" (Dennell 2009), borrowing the term from the Lower Paleolithic

Table 3.4. *Levantine Lower Paleolithic Industries and Representative Assemblages*

Industry	Site and Level	References
Pebble-Core Assemblages	Erq el-Ahmar	Tchernov, (1999)
	Yiron Level 3 (Gravel)	Ronen (1991)
Early Acheulian	Borj Quinnaret	Hours (1975)
	Latamne, Latamne Formation	Clark (1967)
	Nahr el-Kebir, QMIII Formation	Muhesen (1988)
	Sitt Marko, QFIV Formation	Muhesen (1988)
	Ubeidiya Li, Fi Formations	Bar-Yosef and Goren-Inbar (1993)
Early/Middle Acheulian	Gesher Benot Ya'acov	Stekelis (1966), Goren-Inbar et al. (2000, 1996)
	Kaltepe Deresi 3, Levels V–XII	Slimak et al. (2008)
Middle Acheulian	Berzine	Hours (1981)
	Evron Quarry Unit 4	Ronen (1991)
	Joub Jannine II	Hours (1981)
	Nadaouiyeh Level G	Le Tensorer et al. (2007)
	Ouadi Aabet	Fleisch and Sanlaville (1974)
	Umm Qatafa Cave Level D2-E2	Neuville (1951)
Late Acheulian	Azraq Oasis Ain Soda	Rollefson et al. (1997)
	Azraq Oasis C Spring	Copeland (1991a)
	Azraq Oasis Lion's Spring (Ain el-Assad)	Rollefson (1980)
	Berekhat Ram	Goren-Inbar (1985)
	Gharmacji Ib	Muhesen (1985)
	Holon D	Chazan Horwitz (2007)
	Kissufim	Ronen et al. (1972)
	Maayan Barukh	Stekelis and Gilead (1966)
	Mashari'a 1 (Tabaqat Fahl)	Macumber and Edwards (1997)
	Nadaouiyeh Levels B-F	Le Tensorer et al. (2007)
	Revadim	Marder et al. (2011)
	Tabun Cave Level Ec-F/Units XII–XIII	Garrod (1937b), Jelinek (1982a, 1982b)
	Umm Qatafa Cave Level D1	Neuville (1951)
	Wadi Qalkha (J501)	Henry (1995c)

(*continued*)

Table 3.4 (*continued*)

Industry	Site and Level	References
Tayacian	Bezez Cave Level C (base)	Copeland (2003)
	Bizat Ruhama Level C1	Zaidner et al. (2003)
	Dursunlu	Güleç et al. (1999)
	Hummal Levels 13–18	Le Tensorer et al. (2007)
	Kaltepe Deresi 3, Levels II and III	Slimak et al. (2008)
	Karaïn Cave E, Unit A (Levels 57–61)	Otte et al. (1998a)
	Kefar Menahem	Gilead and Israel (1975)
	Ras Beirut Ib	Copeland (2003)
	Tabun Cave Level G/Unit XIV	Garrod (1937b), Shifroni and Ronen (2000)
	Umm Qatafa Cave Levels E3–G2	Neuville (1951)
Acheulo-Yabrudian	Abri Zumoffen Levels 9–21	Roe (1983)
	Abu Sif Level E	Neuville (1951)
	Bezez Cave Level C	Roe (1983)
	Karaïn Cave Units B–E (Levels 33–56)	Otte et al. (1998a)
	Masloukh	Skinner (1970)
	Misliya Cave Upper & Lower Terrace	Zaidner et al. (2006)
	Tabun Level Ea-Eb/Units XI–X	Garrod (1937b), Jelinek (1982a, 1982b), Shifroni and Ronen (2000)
	Yabrud Shelter I, Levels 11–18	Rust (1950), Solecki and Solecki (1986)
	Zuttiyeh Cave	Turville-Petre (1927), Gisis and Bar-Yosef (1974)

research in East Africa (Leakey 1971). One problem with this borrowing is that few Eurasian Oldowan assemblages are as old as their African counterparts (2.6–1.4 Ma). A second concern is that the use of a single term for all these assemblages, which are associated with no fewer than three hominin genera, almost assuredly overlooks significant technological, geographic, and chronological differences among the assemblages (Plummer 2004).

In the Levant, the most plausible Oldowan-age PCAs are from Yiron, and Erq el-Ahmar (both in Israel and dating to around 2.2–2.4 Ma). Both these assemblages are problematical. Neither one has been evaluated in terms of the criteria (set forth in Table 3.2) for differentiating ecofacts from lithic artifacts. The half dozen artifacts recovered by surface collection and section cleaning at Erq el-Ahmar have never been formally described. They are claimed to be associated with the remains of a single adult proboscidian (*Mammuthus tamanensis*) (Tchernov 1999), but excavations at that site did not recover any artifacts *in situ*, nor was there evidence for hominin modification of the elephant skeletal remains. The date for the Yiron assemblage rests on a stratigraphic correlation between gravels overlain by a dated basalt flow and gravels containing stone tools located across the gorge from the artifact-bearing deposits at the site (Ronen 2006).

Acheulian

The defining feature of Acheulian assemblages is that they contain significant numbers of LCTs. The exact percentage of artifacts that LCTs must comprise for an assemblage to be designated "Acheulian" varies among researchers. This is usually a percentage of cores and retouched tools. Following M. Leakey (1971), most African prehistorians fix this percentage at 40 percent, whereas other European prehistorians follow Bordes (1961) in accepting assemblages with fewer bifaces as Acheulian. The name "Acheulian" (also spelled "Acheulean" in many sources) is derived from St. Acheul (France) where these LCTs were first recognized by nineteenth-century researchers.

Early in the course of Levantine Paleolithic research, prehistorians identified a stage-wise sequence of Acheulian industries, based mainly on changes in LCT morphology. Some use the terms Early, Middle, and Late for these Acheulian stages; others use the terms Lower, Middle, and Upper. Many Levantine prehistorians treat these stages as a relative chronology, but few researchers accept the typological characteristics of Acheulian assemblages as reliable indicators of precise age.

Early Acheulian

Early Acheulian assemblages contain large numbers of picks, including trihedral forms, as well as small retouched tools. Exemplary Early

Acheulian assemblages are known from Ubeidiya and Latamne. Most Early Acheulian assemblages date to more than 0.7 Ma and have strong typological parallels with assemblages of comparable age from East Africa, most notably in the production of LCTs from large flakes.

Middle Acheulian

Middle Acheulian assemblages are marked by the presence of large numbers of ovates and cleavers as well as by deeply invasive scar patterns suggesting the use of soft-hammer percussion. In the northern Levant, there are thought to be coastal and inland variants of the Middle Acheulian. Coastal assemblages, such as those from Berzine and Ouadi Aabet, feature LCT inventories dominated by oval and amygdaloid shapes. Inland assemblages, such as Joub Jannine II, feature greater numbers of lanceolates and trihedral LCTs. Middle Acheulian assemblages are thought to date to between 0.7 and 0.4 Ma, but most of these age estimates are based on stratigraphic correlations rather than actual geochronometric dates.

The lithic assemblages from Gesher Benot Ya'acov do not fit comfortably into either the Levantine Lower or Middle Acheulian. Instead, as Sharon (2007) has argued, they seem more similar to "Acheulian Large Flake (sic)" assemblages from equatorial and northern Africa and southern Asia. Such assemblages are marked by a variety of "giant core" techniques for producing large flakes (i.e., ones >10 cm long), often out of coarse-grained rocks, such as basalt and quartzite, that were subsequently modified by minimal marginal retouch into cleavers and ovate handaxes and other LCTs (Madsen and Goren-Inbar 2004). Such giant core techniques first appear in African contexts dating to at least 1.6–1.4 Ma and persist in Africa until later – at least later Middle Pleistocene times (e.g., ca. 0.3 Ma in the Kapthurin Beds of Lake Baringo, Kenya). This widespread and long lasting distribution, and its internal technological variability, makes it improbable that Acheulian Large Flake assemblages correspond to a single hominin population, adaptive strategy, or to anything like a recent human culture. Gesher Benot Yaacov is thus far the best known Levantine Acheulian Large Flake assemblage.

Late Acheulian

Late Acheulian assemblages (also called "Upper Acheulian") feature large numbers of sharply pointed (Micoquian) handaxes and relatively

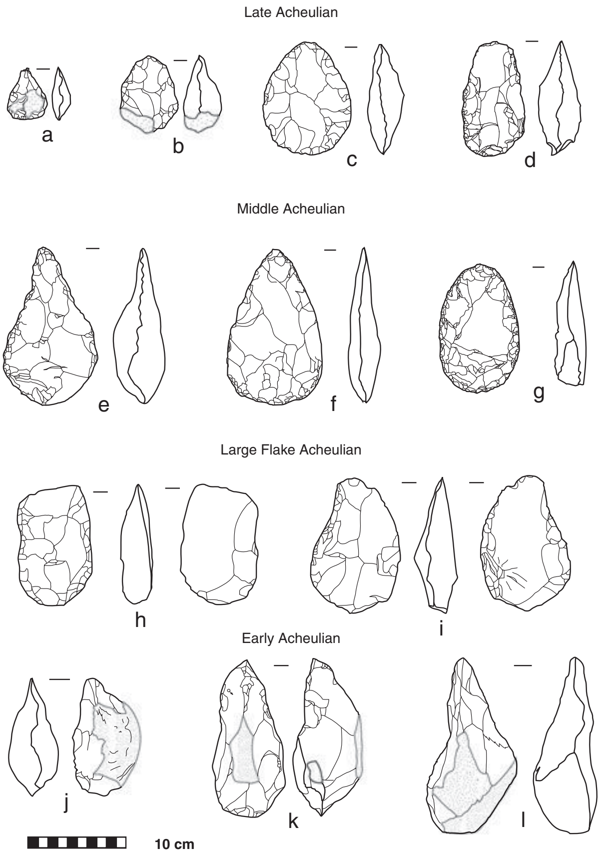


FIGURE 3.11. Chronological variation in Acheulian bifaces. *Sources:* Revadim (a), Maayan Barukh (b, e–g), Gharmachi Ib (c), Azraq Lion Spring (d), Gesher Benot Ya'acov (h–i), Latamne (j–k), Ubeidiya (l). Redrawn after Clark (1967), Copeland (1989b), Goren-Inbar and Saragusti (1996), Hours (1986), Marder et al. (2011), Sharon et al. (2010), and Stekelis and Gilead (1966). Scale is approximate.

large scrapers. Late Acheulian "Samoukian" assemblages from the Northern Levant preserve evidence for the use of radial/centripetal Levallois core reduction techniques which are otherwise rare (Copeland and Hours 1981, Muhesen 1985). Dates for Late Acheulian assemblages are typically younger than 0.5 Ma, but older than 0.2 Ma.

There are differences between LCTs from Early, Middle, and Late Acheulian contexts, but there are few hard-and-fast correspondences between particular LCTs and specific phases of the Acheulian. Figure 3.11 arranges LCTs from Levantine Early, Middle, and Late Acheulian contexts along a rough chronological axis running from top (Early) to bottom (Late). Large picks and lanceolate forms occur in Early Acheulian assemblages, ovates and cleaver in Middle Acheulian assemblages, and small Micoquian forms mainly in Late Acheulian assemblages. Mean length values for bifacial LCTs seem to decline over time (Bar-Yosef 1975, Gilead 1970).

Tayacian

Levantine prehistorians use the name "Tayacian" for Lower Paleolithic assemblages contemporaneous with Acheulian assemblages that lack LCTs, and that are instead dominated by the products of pebble-core reduction. Tayacian assemblages were first recognized at La Micoque Cave near Tayac (France), and the term has been applied broadly throughout Europe, the Levant, and North Africa. Alternative terms for Levantine Tayacian assemblages include "Tabunian" (for Tabun Level G), "Nagilan" (for Bizat Ruhama), and "Shemshian" (for Yabrud IV), or occasionally "Clactonian" (a British Lower Paleolithic industry). Tayacian cores are primarily pebble cores. LCTs and Levallois flakes are absent or rare. Retouched flake tools are mostly notches, denticulates, scrapers, and small steep-edged awls/points ("Tayac points") (Figure 3.12.b).

Levantine Tayacian and Acheulian assemblages overlap geographically and chronologically, but relatively few assemblages of either group are reliably dated. Tayacian assemblages precede Late Acheulian assemblages in cave/rockshelter deposits at Umm Qatafa and Tabun. However, the sounding trenches that reached Tayacian layers in these caves were very narrow. The assemblages recovered from these contexts may under-represent the actual range of assemblage variation from these deeper cave levels.

Many of the distinctive features of Tayacian assemblages are related to pebble-core reduction and the absence of LCT-related technology. Similar assemblages occur alongside Acheulian assemblages in Africa, Europe, and Asia.

Acheulo-Yabrudian

The term "Acheulo-Yabrudian" was originally coined by Rust (1950) for assemblages he recovered from Yabrud Cave in Syria. Diagnostic

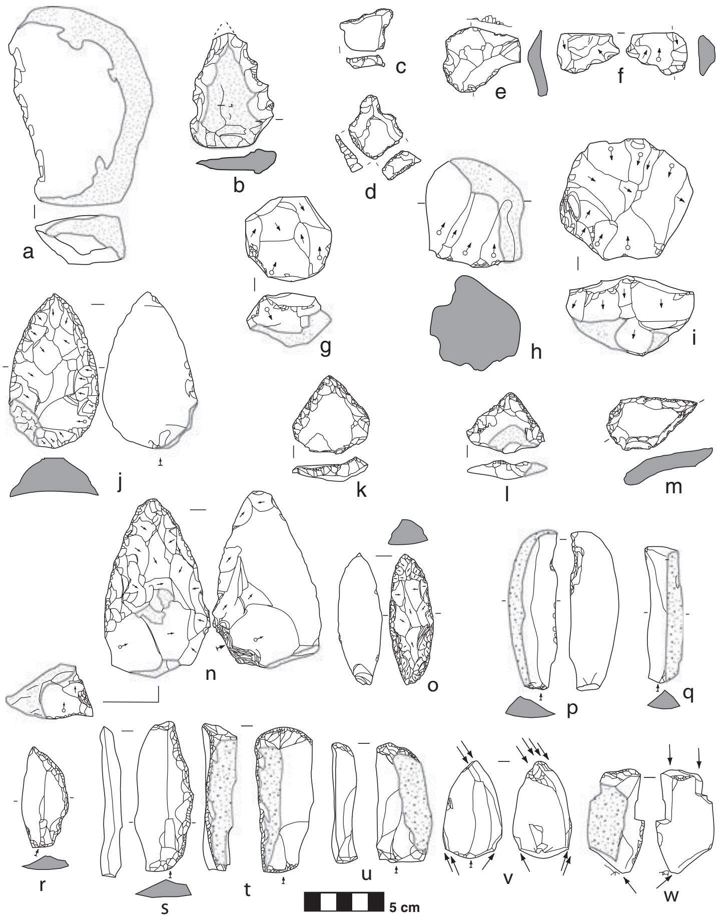


FIGURE 3.12. Characteristic Tayacian (a–i) and Acheulo-Yabrudian (j–w) retouched tools (p–w are considered distinctively "Amudian" blade tools): a. large cortical flake, b. Tayac point, c–e. small retouched flakes, f. small core, g–i. pebble-cores, j–n. transverse and/or convergent scrapers, o. limace, p. notched blade, q. naturally backed knife, r–s. backed blades, t–u. endscrapers, v–w. burins. *Sources:* Ras Beirut (a), Adlun, Bezez Cave Level C (b–j, l, n–o), Qesem Cave (p–w), Yabrud Shelter 1, Level 24 9(k, m). Redrawn after Barkai et al., (2006), Copeland (1983b: plates C.23, C.25), Copeland (2000), Copeland (2003: 100), Gopher et al., (2005), and Rust (1950).

features of Acheulo-Yabrudian assemblages include Micoquian handaxes, large steeply retouched transverse and canted scrapers (Figure 3.12.j–o), and occasional evidence for systematic blade production (Figure 3.12.p–w). Acheulo-Yabrudian assemblages occur in the northern and central Levant (Lebanon, Syria, and northern Israel).

Acheulo-Yabrudian assemblages date to around 0.4–0.3 Ma. They have been variously treated as a final manifestation of the Lower Paleolithic, as an early Middle Paleolithic industry, and as a truly Lower-Middle Paleolithic "transitional" entity (Bordes 1977, Copeland and Hours 1981, Jelinek 1982a, Le Tensorer and Hours 1989). On the basis of his excavations at Tabun Cave, Jelinek (1982a, 1982b) further refined the definition of the Acheulo-Yabrudian into three distinct assemblage groups:

- *Acheulian* assemblages characterized by relatively high percentages (up to 15%) of bifacial LCTs and otherwise low frequencies of retouched tools.
- *Yabrudian* assemblages marked by high frequencies of retouched tools (>40–50 percent among all artifacts) and few bifaces. Among retouched tools, steeply retouched transverse, convergent, and canted scrapers are particularly common.
- *Amudian* assemblages with high frequencies of whole flakes and of blades and retouched tools made on blades (burins, endscrapers, backed knives). (In older works, Amudian assemblages are often described as "Pre-Aurignacian" (Garrod 1956, Rust 1950), a term implying a cultural connection to the European early Upper Paleolithic "Aurignacian" industry.) The term "Amudian" comes from the Amud Valley, in the eastern Galilee, in which Zuttiyeh Cave is located.

All three Acheulo-Yabrudian assemblage-groups share very low frequencies of Levallois cores and Levallois flakes. Most researchers have adopted Jelinek's terminology, although some working in the northern Levant treat the Yabrudian as a distinct industry in it own right. There is still much debate about the distinctiveness of this named assemblage-group and about the relationship between Acheulo-Yabrudian and contemporaneous Late Acheulian assemblages. On the basis of his excavation and analysis of the Tabun Cave assemblages, Jelinek proposed that there was continuity between Acheulo-Yabrudian and early Levantine Mousterian assemblages (Jelinek 1982a). The principal objections to this argument concern the role that subsidence and stratigraphic mixing may play in the formation of "transitional" Lower-Middle Paleolithic assemblages in Tabun Unit X (Bar-Yosef 1994).

VII. OVERVIEW AND CONCLUSION

The lithic technology of the Lower Paleolithic Levant contrasts with the lithic record before 1.5 Ma in Africa and elsewhere in Eurasia mainly in lacking a long pebble-core-using prolog to the appearance of large cutting tools. The production of large cutting tools only became common in most parts of Africa and southern Asia after 1.5 Ma. Therefore, this unique aspect of the Levantine record could reflect either a late hominin colonization of the Levant or the scarcity of Levantine sites dating prior to 1.5 Ma.

There are a few Lower Paleolithic artifact-types, such as trihedral picks and Yabrudian scrapers and blade tools that appear to be unique to the Levant, or very nearly so; but in most other respects, the Levantine lithic evidence differs little from the Lower Paleolithic of adjacent regions.

Ways to Improve the Lower Paleolithic Lithic Evidence

Two changes to the lithic record for the Lower Paleolithic Period in the Near East could improve its value for prehistory. The first would be to collapse some of the contingencies in artifact typology (particularly for pebble-cores and LCTs). The second would be to abandon the use of named lithic industries for all but the most recent phases of the later Middle Pleistocene.

Levantine prehistory recognizes as many as a dozen kinds of pebble-cores and twenty named LCT types. In both cases, this seems excessive. Few patterns have been discovered in either the chronological or geographic distribution of various pebble-core types. Simply classifying pebble cores as choppers, discoids, and polyhedrons would save a lot of time. Similarly, most of the typological distinctions made among LCTs come from the Bordes typology. The effort necessary to classify LCTs from Southwest Asian contexts in terms of Bordes's types does not seem justifiable in terms of their analytical value. A simple tripartite classification as handaxes, cleavers, and picks/protobifaces, would likely suffice for basic descriptive purposes, provided it is augmented by more detailed measurements and attribute-based studies.

It is even more difficult to justify continued using named Lower Paleolithic industries. The Oldowan, Acheulian, Tayacian, Yabrudian, and others were coined early in the history of Paleolithic research to address chronostratigraphic problems that were long ago solved by geochronometric dating. We now know assemblages referable to these industries are distributed over hundreds of thousands of years, far beyond the scale at which analogies between ethnographic or historical groupings of humans and Lower Paleolithic stone tool industries remain plausible. Nearly every study of technological variability among these industries reveals internal variability, variability that may be evolutionarily significant. Using the same names for heterogeneous groups of assemblages makes it difficult for archaeologists to recognize this variability. Comparing Lower Paleolithic assemblages to one another in terms of some multivariate register of technological and typological variability would be a better way of characterizing this evidence.

4

THE MIDDLE PALEOLITHIC

I. INTRODUCTION

During the Middle Paleolithic Period (ca. 245–45/47 Ka) *Homo heidelbergensis* populations evolved into *Homo sapiens* in Africa and *Homo neanderthalensis* (Neanderthals) in western Eurasia. These parallel processes took place during the final glacial cycles of the Middle Pleistocene and the early Upper Pleistocene. For most of this period, global climates were relatively cool and dry, but there were wide fluctuations in regional temperature and humidity (Burroughs 2005) in the East Mediterranean Levant (Bar-Matthews and Ayalon 2004, McGarry et al. 2004).

Middle Paleolithic Hominin Behavioral Evolution

In terms of hominin behavior, the Middle Paleolithic Period saw increased regional variability and greater complexity. In contrast to the Lower Paleolithic, where essentially similar techniques and artifact types occurred wherever hominins established themselves, Middle Paleolithic assemblages preserve evidence for regionally distinctive lithic typologies and sequential changes in lithic technology that differ from region to region. Aspects of behavioral complexity that seem to emerge in the Middle Paleolithic include systematic big-game hunting, the production and use of exosomatic symbols (mineral pigments, personal adornments), the social use of symbols (burials with grave goods), pyrotechnology (heat-treatment of lithic materials), hafted stone tools, tools carved out of bone, and systematic exploitation of small game. That these developments do not conform either to a model of a single behavioral "revolution" or to a gradual cumulative process has fueled much speculation about the underlying evolutionary processes involved. Some researchers attribute the irregular patterning of the evidence for these behaviors during the Middle Paleolithic to organic behavioral differences between Middle Paleolithic versus later hominins, others to social-demographic differences, and still others to theoretical biases and sample error issues (Henshilwood and Marean 2003, Klein and Edgar 2002, McBrearty and Brooks 2000, Mellars 2007, Nowell 2010, Shea 2011b, Shea 2011c).

The Middle Paleolithic Archaeological Record

The Levantine Middle Paleolithic archaeological record is informed by the results of excavations at several dozen localities of which the most important (from a lithic standpoint) are listed Table 4.1 and mapped in Figure 4.1 (Bar-Yosef 2000, Hovers 2009, Shea 2003). Neanderthals' and early *Homo sapiens*' geographic ranges overlapped with each other in the Levant during the Middle Paleolithic Period prior to 45 Ka. Fossils referable to *Homo neanderthalensis* are known from the sites of Tabun, Amud, Kebara, Geulah B, Shukhbah, Dederiyeh, and (stretching the definition of the Levant a bit) Shanidar Cave in Iraq. Fossils referable to early *Homo sapiens* have been recovered from Middle Paleolithic contexts at Skhul and Qafzeh. Paleoanthropologists have long assumed that Neanderthals and early *Homo sapiens* encountered one another in the Levant (Hovers 2009, Shea 2003), although proof of such interactions is largely something inferred by genetic studies, rather than something demonstrable stratigraphically (Shea 2011a, Shea 2011d).

Middle Paleolithic Lithics References

Historically, Levantine Middle Paleolithic assemblages have been treated as an extension of a larger European "Mousterian" Industrial Complex, and, (since the 1960s), described in terms of the typology developed by François Bordes for use in western Europe (1961, Debénath and Dibble 1994, Hours 1974). Retouched tools are much

Table 4.1. *Key Middle Paleolithic Sites Discussed in this Chapter*

Sites and Levels	Reference
Samples from the East Mediterranean Region	
'Ain Difla Rockshelter (WHS 634)	Lindly and Clark (1987)
Abu Sif Levels B–C	Neuville (1951)
Amud Cave Level B1–B4	Suzuki and Takai (1970), Hovers (2004)
Ar Rasfa	Ahmad and Shea (2009)
Azraq Oasis sites	Copeland and Hours (1989)
Bezez Cave Level B,	Copeland (1983a)
Biqat Quneitra Areas A & B	Goren-Inbar (1990a)
Dederiyeh Cave Levels (SU) I–IV	Akazawa and Muhesen (2002)
Douara Cave Units I–IV	Akazawa and Sakaguchi (1987)
el Wad Cave Level G	Garrod (1937a)
Far'ah II	Gilead and Grigson (1984)
Geulah Cave B	Wreschner (1967)
Har Oded	Boutié and Rosen (1989)
Hayonim Cave Levels Lower E–F (& G?)	Meignen (1998)
Hummal 1a	Le Tensorer et al. (2007)
Jerf Ajla Cave Levels B–F	Julig et al. (1999)
Kebara Cave Units VII–XII/Level F	Bar-Yosef and Meignen (2008), Schick and Stekelis (1977)
Keoue Cave Units I–III,	Nishiaki and Copeland (1992)
Ksar Akil Rockshelter XXVIII–XXVII	Marks and Volkman (1986)
Misliya Cave Unit II	Weinstein-EvRon et al. (2003)
Naamé	Fleisch (1970)
Nahal Aqev (D35)	Munday (1976)
Nahal Mizpe Ramon	Boutié and Rosen (1989)
Qafzeh Cave Levels G–L, 12–13, Terrace Units L, I–XXIV	Hovers (2009)
Ras el-Kelb Railway Trench A–D and Tunnel Trench J–O	Copeland and Moloney (1998)
Rosh Ein Mor (D15)	Crew (1976), Monigal (2001)
Sefunim Cave Levels 12–13, Shelter Levels A–C	Ronen (1984)
Shovakh Cave Units I–IV	Binford (1966)
Shukhbah Cave Level D	Garrod and Bate (1942), Callander (2004)
Skhul Cave Level	McCown (1937)
Tabun Cave Levels B–D, Units I–IX	Garrod (1937b), Jelinek(1982a, 1982b)
Tirat Carmel	Ronen (1974)

(*continued*)

Table 4.1 (*continued*)

Sites and Levels	Reference
Tor Faraj Rockshelter Level C	Henry (1995b, 2003)
Tor Sabiha Rockshelter Level C	Henry (1995b)
Umm el Tlel Levels IV 2βa, IV 2γ/δa, and VI 1 a0	Boëda et al. (2001)
Yabrud Rockshelter 1	Rust (1950), Solecki and Solecki (1995)
Samples from the Montane Northern Levant	
Bisitun Cave	Dibble (1984)
Gar Arjeneh and Gar Kobeh caves	Lindly (2005)
Hazar Merd Cave	Garrod (1930)
Karaïn Cave Levels F–I	Otte et al. (1995)
Kunji Cave Level 2	Baumler and Speth (1993)
Shanidar Cave Level D	Solecki (1971) Akazawa (1975)
Warwasi Cave	Dibble and Holdaway (1993)

less common among Levantine assemblages than they are among European assemblages. Consequently, Levantine researchers emphasize the importance of technological (versus typological) variation in inter-assemblage comparisons and higher-order systematics. The Middle Paleolithic evidence from the Taurus-Zagros mountain ranges is often treated together with that from the East Mediterranean Levant, even though, as discussed in the next section, the two differ from one another in many ways.

II. MIDDLE PALEOLITHIC CORE TECHNOLOGY

"Levallois" prepared-core techniques ("parallel cores" in the Conard et al. (2004) classification) proliferated during the Middle Paleolithic Period in much of Africa and Eurasia. Prepared/parallel cores were already used by Lower Paleolithic hominins, and in actuality, what changes during the Middle Paleolithic is not so much the underlying core technology, but the scale at which it is applied. Formerly used to produce large flakes, many of which were further modified into LCTs, Middle Paleolithic parallel cores were scaled down to produce smaller and thinner flakes that were retouched into a wide range of tool forms. Pebble core technology was used during Middle Paleolithic times, and LCTs continued to be deposited, albeit in low frequencies.

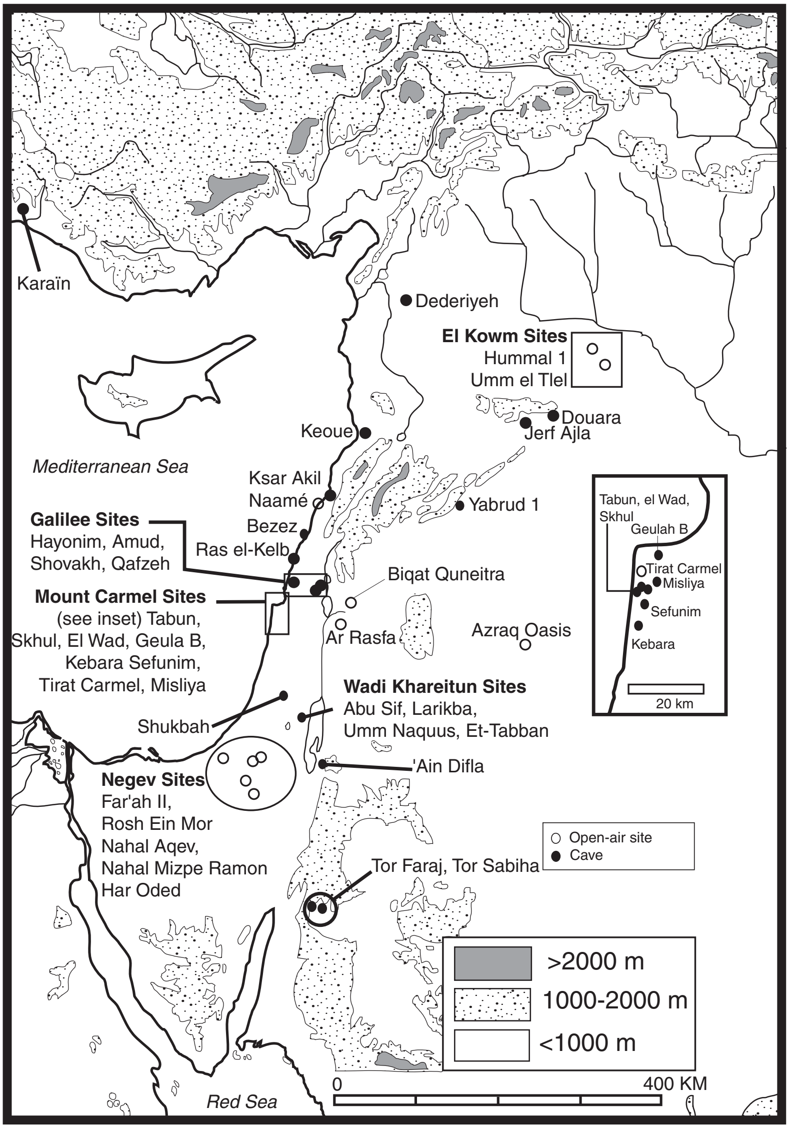


FIGURE 4.1. Map showing important Middle Paleolithic sites.

Levallois Core Technology

"Levallois technology" is not a single thing, but encompasses a wide range of core reduction strategies (Boëda 1995). All Levallois techniques share the same hierarchical arrangement of the core into stable striking platforms and flake-release surfaces (Chazan 1997) (see

Figure 4.2). Their characteristic core-trimming elements result from efforts to reduce distal and lateral convexities on flake-release surfaces. Many of flakes produced by Levallois core reduction also feature outwardly curving and facetted striking platforms. These features reflect efforts to isolate the point of percussion from adjacent parts of the core's working edge. Isolating the point of percussion enables fractures to propagate further across flake-release surfaces than would otherwise be the case.

The most fundamental division among Levallois core reduction strategies is between preferential and recurrent methods (Inizan et al. 1999) (see Figure 4.3). In preferential methods, each cycle of core exploitation is punctuated by the detachment of a single large flake from the center of the flake-release surface. This flake is usually larger and more symmetrical than other flakes detached from the same face of the core. Recurrent Levallois methods detach flakes of broadly similar size and shape, one after another, until flake propagation failures require substantial modification of the core. Further taxonomic distinctions among different modes of Levallois core reduction take into account the preparation of the flake-release surface inferred from the alignment of flake scars on cores and on the dorsal surfaces of flakes. Levantine prehistorians recognize four major modes of Levallois core preparation: unidirectional-parallel, unidirectional-convergent, bidirectional-opposed, and radial-centripetal.

There are differences in how cores with recurrent radial-centripetal preparation are treated by different lithic analysts. Such cores are often separated from other Levallois products as "discoidal" cores, even though they show a hierarchy of flake-release and striking platform surfaces. The main argument for such separate treatment is that these cores do not show evidence for the management of distal and lateral convexities in the same way as other Levallois cores do. The countervailing argument for including cores with recurrent radial-centripetal preparation among Levallois cores is that flakes detached from these cores effectively manage distal and lateral convexities by virtue of their short propagation distance and broad, laterally skewed striking platforms.

Products of Levallois Core Technology

Levallois cores are parallel cores. As such, the flakes detached from them are divisible into shorter flakes detached in the service of

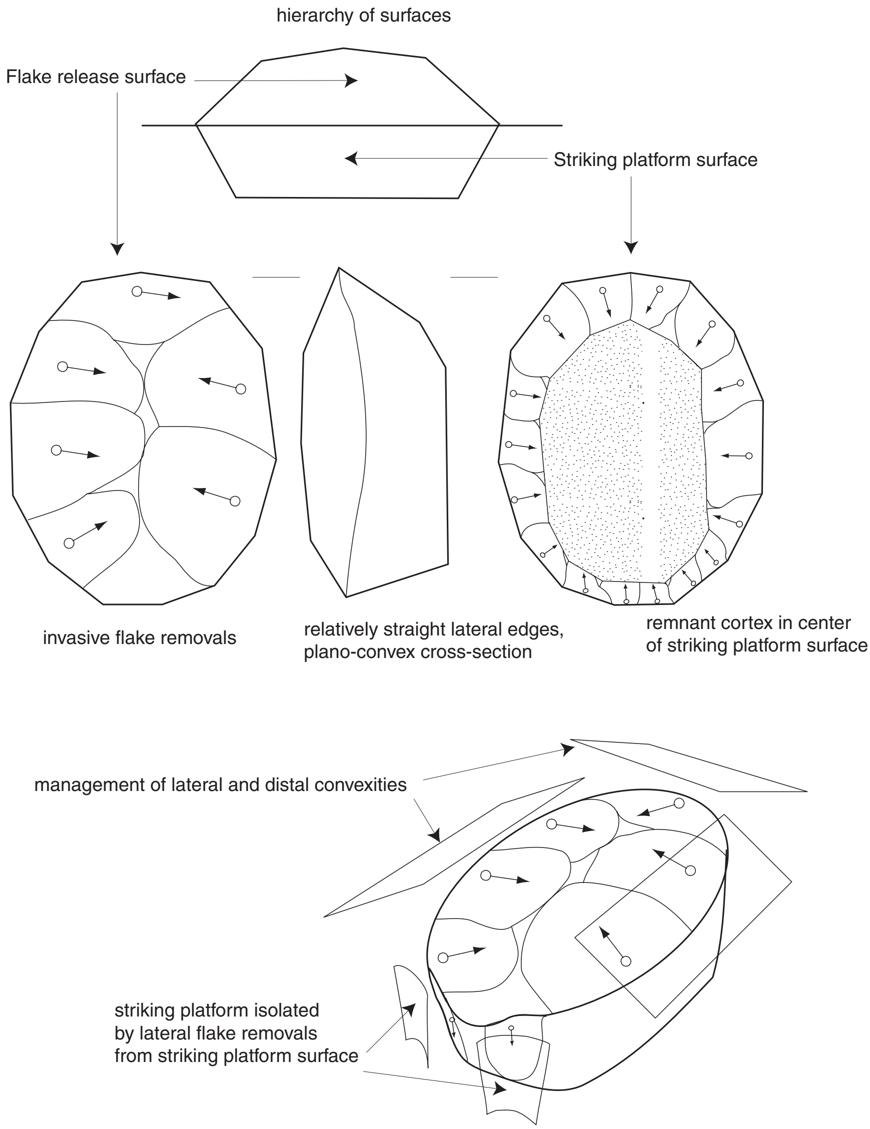


FIGURE 4.2. Key features of Levallois cores.

preparing the striking platform surface and longer flakes detached from the flake-release surface. It is difficult to generalize about Levallois platform preparation flakes. Experiments attempting to replicate Levallois technology suggest platform preparation flakes will usually have either plain or dihedral striking platforms, cortical or partly

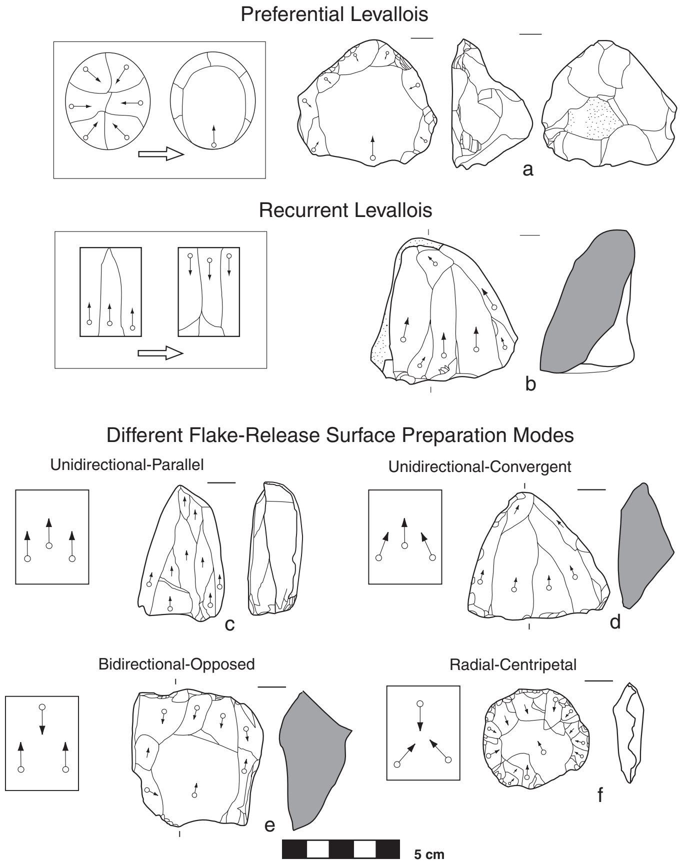


FIGURE 4.3. Technological variability in Levallois core technology: a. preferential Levallois removal, b. recurrent Levallois removal, c. unidirectional-parallel preparation, d. unidirectional-convergent preparation, e. bidirectional-opposed preparation, f. radial-centripetal preparation. Sources: Ar Rasfa (a), Har Oded (b), Hayonim (c), Nahal Mizpe Ramon surface (d), Har Oded surface (e), Biqat Quneitra (f).Redrawn after Ahmad and Shea (2009), Boutié and Rosen (1989), Goren-Inbar (1990b), and Meignen (1998).

cortical surfaces, and relatively high external platform angles (Boëda 1988, Geneste 1985). These are features shared with débitage detached from many other kinds of knapping operations, including the initial preparation of the flake-release surface.

Flakes detached from release surfaces of Levallois cores are more distinctive. These are relatively long, with facetted striking platforms, multiple flake scars on their dorsal surface, and relatively little cortex

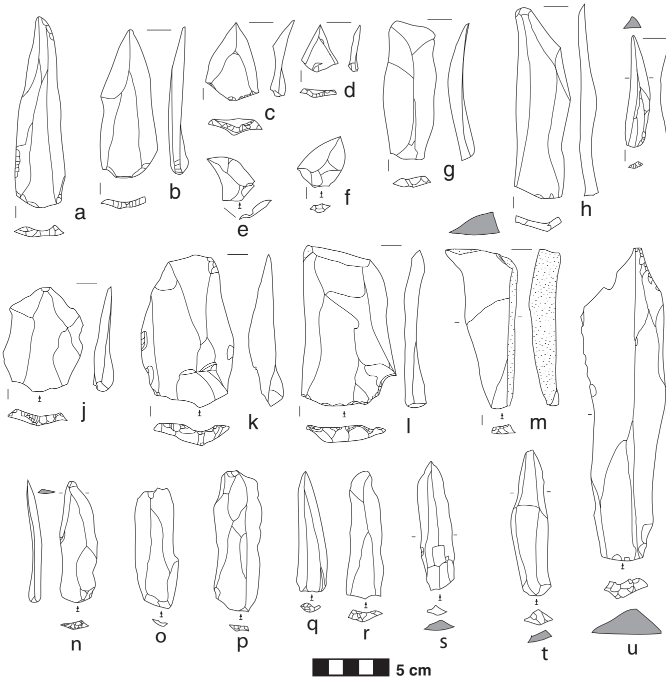


FIGURE 4.4. Levallois points, blades, flakes and prismatic blades. a–b. elongated Levallois points, c–d "typical" Levallois points, e–f. pseudo-Lev points, g–i. Levallois blades, j–k. typical Levallois flakes, l–m. "atypical" Levallois flakes, n–v. Levallois and non-Levallois blades. Sources: 'Ain Difla/WHS 634 (a–b), Kebara (c–d, o–p), Ras el-Kelb (e–f), Amud (i–n), Ar Rasfa (g–h, j–m), Rosh Ein Mor (q–r), Douara (s–t), Hummal Spring αh (u). Redrawn after Ahmad and Shea (2009), Boëda et al. (1990), Copeland and Moloney (1998), Crew (1976), Hovers (1998), Le Tensorer et al. (2007), Lindly and Clark (1987), Meignen and Bar-Yosef (1988), and Nishiaki (1987).

(Figure 4.4). Among such Levallois artifacts, Bordes's typology distinguishes artifacts that are mediolaterally symmetrical as "typical" and those that are asymmetrical as "atypical."

A typical Levallois flake (Type 1 in Bordes's typology) is a broad, thin mediolaterally symmetrical flake with outwardly curving and unifacially facetted striking platform, and no cortex on its dorsal side. Deeply invasive flake scars traverse the dorsal surface. An atypical Levallois flake (Type 2) differs from a typical Levallois flake mainly in being asymmetrical and/or partly cortical. Somewhat counterintuitively, traditional typology classifies Levallois blades (which can be symmetrical and non-cortical) as atypical Levallois flakes. Levallois points are unretouched triangular flakes. Although traditional Bordian typology does not distinguish between elongated and shorter (isosceles) Levallois flakes, Levantine prehistorians often sort Levallois points into "normal/short" and "elongated" forms. Elongated points have length values greater than or equal to twice their width. Thus, a pointed Levallois blade could, in principle, be identified as either an elongated Levallois point or a Levallois blade. Pseudo-Levallois points (Type 5) are roughly triangular in plan view, but with morphological and technological axes offset from one another. Naturally backed knives (Type 38) are elongated and mediolaterally asymmetrical flakes on which one lateral edge is steep and/or cortical while the opposite edge is sharp and non-cortical.

The use of English "typical/atypical" for French "*typique/atypique*" is a source of much confusion, because of the English terms' statistical connotations. It is often the case among Levantine assemblages that atypical examples of particular Bordian artifact-types are more common than typical ones. The term "atypical" can also be read to imply that these artifacts are in some way knapping errors, but this is not necessarily the case. The asymmetry that defines them reflects either (1) lateral "rolling" of the fracture during propagation, or (2) the concavity of the flake-release surface. In the first case, the plane of fracture propagation rolls laterally, undercutting the lateral margin of the flake-release surface. The resulting Levallois flakes are often mediolaterally asymmetrical with cortex on their lateral and/or distal edges. By rolling away from the plane of the flake-release surface they maintain the convexity of that surface that is essential to further flakes being detached from it. For this reason, such flakes can be viewed as core-trimming elements detached at early stages in core reduction rather than as knapping errors (although some may indeed be errors).

Naturally backed knives can be interpreted in a similar fashion. Elongated flakes with one relatively steep lateral edge, often cortical, are detached during the initial stages of core preparation. As successive flakes are detached from the flake-release surface of a Levallois core, the center of that surface becomes increasingly concave. This concavity can pose an obstacle to subsequent fracture propagation. Specifically, flakes propagating under a concavity can be slowed or stopped short as the thickness of raw material between the fracture plane and the surface of the core increases at the other side of the concavity. The resulting asymmetrical flakes often have irregularly shaped edges, but such variability in edge shape can be a desirable quality if one is trying to create functionally versatile tools.

The name, "pseudo-Levallois points" implies an effort to imitate symmetrical Levallois points. In fact, pseudo-Levallois points are common products of discoidal core reduction. Experimental studies show that the production of pseudo-Levallois points by discoidal core reduction recovers as much cutting edge per unit mass of stone as prismatic blade core reduction (Eren, Greenspan, and Sampson 2008). This finding suggests pseudo-Levallois points were likely desired products in their own right, and not merely approximations of "ideal" symmetrical points.

Increasingly, Levantine prehistorians are adopting a descriptive framework developed by Geneste (1985: 250) for French Mousterian assemblages (Table 4.2 and CUP Website Figure 15). This framework arranges twenty-six technological artifact-types into five major categories ("Phases"): the acquisition and retrieval of material, initial core preparation, core exploitation and reduction, retouch and resharpening, and a residual miscellaneous category.

Geneste's Phase 0, acquisition and retrieval of material, groups together pebbles, cobbles, and other blocks of lithic raw material.

Phase 1, initial core preparation, encompasses cortical artifacts, including initial cortical flakes (those with >50 percent cortex on their dorsal surface), residual cortical flakes (<50 percent cortex), and naturally backed flakes/blades (flakes/blades with cortical lateral edges).

Lithic artifacts referable to Phase 2, core exploitation and reduction, are divided into flake products, cores and core-rejuvenation products, and miscellaneous core exploitation products. The flake products (Types 4–10) include all non-cortical Levallois and non-Levallois flakes, blades, and points. Asymmetrical (atypical) artifacts are distinguished and grouped together (as Type 6) separately from symmetrical/typical artifacts. The cores and core rejuvenation artifacts (Types 11–17) consist of various core types identified on the basis of the pattern of their final flake scars, core fragments, and core-trimming elements (flakes with relict core edges on their dorsal surface or their distal and/or lateral edges). Cores-on-flakes, flakes with ventral retouch, Kombewa flakes, and non-cortical flake fragments are assigned to a "miscellaneous" category.

Table 4.2. *Geneste's (1985: 250) Typology of Middle Paleolithic Débitage Products*

Type	Description of Artifact-Type
	PHASE 0. ACQUISITION AND RETRIEVAL OF MATERIAL
0	Block of raw material ("tested" or unmodified)
	PHASE 1. INITIAL CORE PREPARATION
1	Initial cortical flake (>50% cortex)
2	Residual cortical flake (<50% cortex)
3	Naturally backed flake (flake with cortical lateral margin)
	PHASE 2. CORE EXPLOITATION AND REDUCTION
	Flake products
4	Non-Levallois flake.
5	Non-Levallois blade.
6	Atypical Levallois blade, atypical Levallois flake, and flakes with canted (*déjeté*) striking platforms.
7	Levallois flake.
8	Levallois blade.
9	Levallois point.
10	Pseudo-Levallois point.
	Cores & Core Rejuvenation Products
11	Discoidal Core.
12	Various Core types (choppers, polyhedrons, handaxe, biface, prismatic blade core).
13	Levallois flake core, point core.
14	Levallois blade core.
15	Levallois core-edge flake.
16	Core-edge flake, crested flake.
17	Core fragment.
	Miscellaneous Core Exploitation Products
18	Core-on-flake with large removals from ventral or dorsal surface.
19	Flake with small "thinning" removals from ventral surface.
20	Kombewa flake
21	Indeterminate flake fragment without cortex (shattered piece).
	PHASE 3. RETOUCH AND RESHARPENING
22	Biface thinning flake.
23	Small tool retouch flake (includes burin and tranchet flakes).
	PHASE 4. MISCELLANEOUS AND MULTIPLE PHASES
24	Debris – flake fragments with or without cortex >30 mm in at least one dimension.
25	Debris – flake fragments with or without cortex <30 mm in maximum dimension.
26	Small flakes and fragments 10–30 mm.

Phase 3, retouch and resharpening, is represented by only two artifact types, biface-thinning flakes (see Chapter 3) and small tool-retouch flakes. The latter are artifacts that preserve part of a retouched edge on their distal, proximal, or lateral edges. Burin flakes with a retouched edge on their dorsal surface and tranchet flakes are assigned to this artifact group.

Geneste's final category, miscellaneous and multiple phases, encompasses small flakes, flake fragments, and debris of the sort that could result during any number of activities related to material acquisition, core preparation, core reduction, or resharpening.

Variation in Levallois Core Technology

In principle, a competent flintknapper can use any of these Levallois core preparation techniques to detach a flake of a given shape or size. In actuality, Levantine Middle Paleolithic flintknappers appear to have made patterned choices among Levallois core preparation/reduction strategies. Recurrent unidirectional-parallel and bidirectional-opposed methods are prominent among earlier Middle Paleolithic assemblages in which blades and other elongated flakes are common. Unidirectional-convergent preparation is common among later Middle Paleolithic assemblages featuring large numbers of short Levallois points. Recurrent radial-centripetal core reduction is to be found in nearly every Levantine Middle Paleolithic assemblage of any significant size.

Blade Core Technology

The presence of prismatic blades and prismatic blade cores among Levantine Middle Paleolithic assemblages was noticed and remarked on by many early researchers, because it seemed to set these assemblages apart from other "Mousterian" assemblages in western Eurasia and North Africa (Garrod 1962).

Products of Middle Paleolithic Blade Technology

It can be difficult to discriminate between products of recurrent laminar Levallois core reduction and prismatic blade core technology (compare Figure 4.4.g–i to Figure 4.4.n–u). In theory, the two techniques are organized very differently. Laminar Levallois techniques exploit a relatively flatter flake-release surface than prismatic blade techniques. Consequently, Levallois cores have a significantly larger irreducible minimum volume than blade cores (CUP Website Figure 16). In practice, however, some of the products of these core reduction strategies can be indistinguishable from one another. This problem is most acute with blades detached from the central part of the flake-release surface. Unless they also feature a characteristic facetted convex striking platform, such blades provide few clues as to whether they were detached from a Levallois core or from a prismatic blade core. Blades struck from near the lateral margins of the flake-release surface can show, in their mediolateral asymmetry, evidence of their origin from a Levallois core. Blades with plunging fracture propagation trajectories are attributed to prismatic blade production. Blades and naturally backed knives can result from both laminar Levallois and prismatic blade core reduction.

Variation in Levallois Blade Technology

Blades referable to prismatic blade cores occur in many Levantine Middle Paleolithic assemblages, although usually in small numbers. There does not appear to be either strong regional or chronological patterning associated with prismatic blade production. Blade-rich assemblages occur along the Mediterranean coast (e.g., Tabun Unit IX, Bezez Cave, Hayonim Cave), as well as in the interior (e.g., 'Ain Difla, Nahal Aqev, Rosh Ein Mor). The best documented instances of systematic non-Levallois prismatic blade core technology are from Early Middle Paleolithic sites, such as Hummal 1 (Copeland 1981), Rosh Ein Mor (Crew 1976), and Hayonim Cave Levels Lower E–F (Meignen 2000), but examples are also known from Later Middle Paleolithic contexts, such as Amud B (Hovers 1998) and Boker Tachtit Level 1 (Marks and Kaufman 1983). Some researchers have argued that Upper Paleolithic blade technology developed out of Levallois blade production strategies (Meignen 1996, Monigal 2001). Others see a marked break between Levantine Middle and Upper Paleolithic blade production (tostevin 2003).

III. RETOUCHED FLAKE TOOLS

Since the 1960s, retouched tools from Levantine Middle Paleolithic contexts have been described in terms of the numbered and named artifact-types in Bordes's (1961) typology. Table 4.3 lists and defines these Bordian retouched artifact types (see also CUP Website Figures 17 and 18). Bordes's types are distinguished from one another on the basis of several criteria, including the following:

- artifact shape in plan view,
- the number of retouched edges,
- distal/lateral position of retouched edges,
- dorsal and/or ventral location of retouch,
- the shape of the retouched edges in plan view,
- steepness of retouched edges, and
- invasiveness of retouch

The importance of these variables varies among different classes of artifacts. Actual size does not influence typological classification, although relative dimensions play a role in differentiating some artifacts from one another. CUP Website Figure 19 shows a flow chart, adapted from Débenath and Dibble (1994), that demonstrates the steps involved classifying tools using Bordes's typology. Although this flow chart can be an aid to novice typologists, it is important to understand that Bordian typology contains many subtle distinctions and idiosyncratic conventions that can (apparently) only be learned by tutorial with an experienced practitioner of its use.

From an analytical standpoint, the most important groups of Levantine Middle Paleolithic retouched tools are points and scrapers.

Points

There are three main types of Middle Paleolithic retouched points (Figure 4.5): retouched Levallois points, Mousterian points, and elongated Mousterian points. These point types differ from one another mainly in the extent to which they are retouched and their relative degree of elongation. Retouched Levallois points (Type 4) are Levallois points with retouch at their distal end. This retouch is almost always unifacial and located on the dorsal surface, although rare ventrally retouched and bifacially retouched examples are known. Mousterian points (Type 6) are triangular flakes with extensively retouched lateral edges that are either straight or mildly convex in plan view converging to a sharp distal tip. The dividing line between a Mousterian point

Table 4.3. *Retouched Artifact Types from Bordes Typology*

Type No.	Name	Comment
4	Retouched Levallois point	Levallois point with retouch at distal end.
6	Mousterian point	Triangular flake with extensively retouched lateral edges that are either straight or mildly convex in plan view converging to a sharp distal tip.
7	Elongated Mousterian point	Mousterian point whose length is greater than or equal to twice its width.
8	Limace (French for "slug")	Elongated double scraper whose edges converge at distal and proximal ends.
9	Single straight scraper	Flake with one dorsal retouch on one lateral edge. Retouched edge is straight in plan view.
10	Single convex scraper	Flake with one dorsal retouch on one lateral edge. Retouched edge is convex in plan view.
11	Single concave scraper	Flake with one dorsal retouch on one lateral edge. Retouched edge is concave in plan view.
12	Double straight scraper	Flake with both lateral edges retouched on the dorsal face, both straight in plan view.
13	Double straight-convex scraper	Flake with both lateral edges retouched on the dorsal face, one straight, the other convex in plan view.
14	Double straight-concave scraper	Flake with both lateral edges retouched on the dorsal face, one straight, the other concave in plan view.
15	Double convex scraper	Flake with both lateral edges retouched on the dorsal face, both convex in plan view.
16	Double concave scraper	Flake with both lateral edges retouched on the dorsal face, both concave in plan view.
17	Double convex-concave scraper	Flake with both lateral edges retouched, both straight in plan view.
18	Straight convergent scraper	Flake with both lateral edges retouched on the dorsal face, both edges are straight in plan view and converge at the tip.

Type No.	Name	Comment
19	Convex convergent scraper	Flake with both lateral edges retouched on the dorsal face, both edges are convex in plan view and converge at the tip.
20	Concave convergent scraper	Flake with both lateral edges retouched on the dorsal face, both edges are concave in plan view and converge at the tip.
21	Canted (*déjeté*) scraper	Convergent scraper in which one edge is much longer than the other. Such scrapers appear square or trapezoidal in plan view owing to the offset of their technological and morphological axes.
22	Straight transverse scraper	Scraper whose distal end is retouched on the dorsal face. The retouched edge is broad relative to the width of the tool and straight in plan view.
23	Convex transverse scraper	Scraper whose distal end is retouched on the dorsal face. The retouched edge is broad relative to the width of the tool and convex in plan view.
24	Concave transverse scraper	Scraper whose distal end is retouched on the dorsal face. The retouched edge is broad relative to the width of the tool and concave in plan view.
25	Scraper on interior (ventral) surface	Scraper of any shape on which retouch is located on the ventral face of the tool.
26	Abrupt (steeply retouched) scraper	Scraper of any shape on which there is only one retouched edge. The edge is retouched on the dorsal face and it is steeply retouched (around 90°).
27	Scraper with thinned back	Scraper on which the edge opposite the main scraper edge features retouch flake scars that are invasive past the midpoint of its width.
28	Bifacial scraper	Scraper with retouch on dorsal and ventral faces of same edge.
29	Alternate scraper	Scraper with dorsal retouch on one edge and ventral retouch on another edge.

(*continued*)

Table 4.3 (*continued*)

Type No.	Name	Comment
30	Typical endscraper	Scraper with retouch at the distal end. Differs from transverse scrapers in that this edge is relatively narrow compared to the maximum width of the tool.
31	Atypical endscraper	Same as Type No. 30, but with irregular retouch.
32	Typical burin	Flake with either one or more burin flake scars.
33	Atypical burin	Same as Type No. 32, but asymmetrical in some way.
34	Typical awl (or perforator)	Flake or blade with a short pointed projection formed by steep retouch. Retouch is limited to the immediate vicinity of this projection.
35	Atypical awl (or perforator)	Same as Type No. 34, but asymmetrical in some way.
36	Typical backed knife	Flake, generally elongated, with steep (around 90°) retouch along one lateral
37	Atypical backed knife	Same as Type No. 36, but asymmetrical in some way.
39	Raclette	Small, thin flake with abrupt, shallowly invasive retouch.
40	Truncation	Flake with a straight, steeply retouched (around 90°) edge aligned more or less perpendicularly to the long axis of the tool.
41	Mousterian tranchet	Truncated flake fragment with trapezoidal/triangular shape.
42	Notch	Flake with one or more small, discrete, retouched concavities on its lateral edge.
43	Denticulate	Flake with a jagged edge formed by a series of small unevenly spaced notches.
44	Alternate retouched bec ("beak")	Awl whose point is formed by two notches, one on the dorsal, the other on the ventral. The projection of the awl is thick in cross section.
45	Flake with irregular retouch on interior (ventral)	Flake with irregularly spaced retouch on its ventral face.

Type No.	Name	Comment
46	Thick flake or blade with abrupt retouch	Types 46–49 are combined in most analyses.
47	Thick flake or blade with alternating retouch	See description, to left.
48	Thin flake or blade with abrupt retouch	See description, to left.
49	Thin flake or blade with alternating retouch	See description, to left.
50	Bifacially retouched flake	Flake with a bifacial retouch on a portion of its edge.
51	Tayac point	Retouched flake with denticulate retouch on its lateral edges. Lateral edges converge at their distal end.
52	Notched triangle.	Retouched triangular flake with notch.
53	Pseudo-microburin.	Retouched flake with a projection formed by small clusters of retouch on adjacent portions of dorsal and ventral faces.
54	End-notched flake.	Flake with notch on distal end.
55	Hachoir	Large, thick flake with convex bifacially retouched distal end.
56	Push-plane (rabot)	Hemispherical core-scraper.
57	Stemmed point	Retouched or unretouched pointed flake with a retouched tang or stem.
58	Stemmed tool	Flake with a retouched tang or stem.
59	Chopper	Unifacial or bifacial cobble-core with a flaked edge along a portion of its circumference. The flaked edge is straight when viewed edge-on.
60	Inverse chopper	Split pebble with retouch at one end.
61	Chopping Tool	Same as Type No. 59, but with a flaked edge that is jagged or sinuous when viewed edge-on.
62	Miscellaneous	Anything not covered by Type Nos. 1–61 and 63.
63	Bifacial foliate	Thin, bifacially retouched point or flake with rounded proximal end.

and a retouched Levallois point is not clearly demarcated. In practice, Levallois points with retouch extending along their lateral edges past the midpoint of the tool's morphological long axis are usually classified as Mousterian points regardless of whether the flake on which it was made was struck from a Levallois core. Elongated Mousterian points (Type 7) have length values greater than or equal to twice their width. In the southern Levant, elongated Mousterian points are called "Abu Sif knives," after Abu Sif Rockshelter (Neuville 1951). Limaces, elongated pieces pointed at both ends and with a thick cross section are relatively rare in Levantine Middle Paleolithic assemblages. Limaces (Type 8) are more common among Middle Paleolithic assemblages from the Taurus and Zagros Mountains, in which they grade seamlessly into elongated Mousterian points. Although Bordes treated limaces as "points," most Levantine prehistorians view them as a kind of convergent scraper.

Tayac points (Type 51) are triangular pieces with distally convergent and denticulate lateral edges. Most Levantine prehistorians view Tayac point as either convergent scrapers, denticulates, or some combination of both.

Levallois points (retouched and unretouched) vary widely in their frequency among Levantine Middle Paleolithic assemblages. They are more common in the earliest and youngest dated assemblages. They are also more common at sites from the southern and interior parts of the Levant than they are in coastal sites (Shea 1998).

Scrapers

Bordes's typology divides scrapers into four major groups: single scrapers, double scrapers, convergent scrapers, and transverse/endscrapers. The retouch on these scrapers is usually on the dorsal face (Figure 4.6.a–h).

Single scrapers (Types 9 and 10) feature one retouched lateral edge and are further subdivided on the basis of whether that retouched edge is straight, convex, or concave in plan view.

Double scrapers (Types 11–17) preserve retouch on both lateral edges. Six types of double scrapers are recognized on the basis of their particular combinations of edge shapes: double straight, straight/convex, straight/concave, double convex, double concave, and concave/convex.

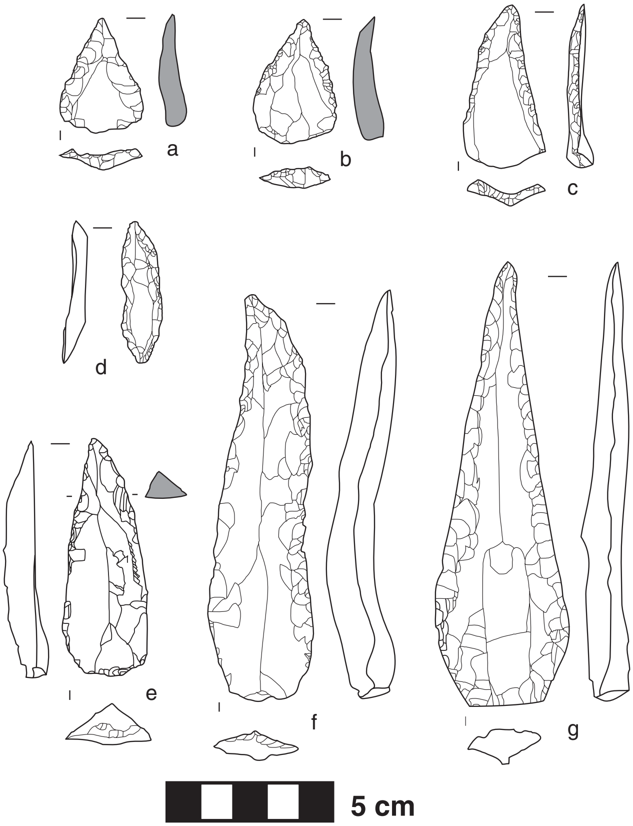


FIGURE 4.5. Retouched points from Middle Paleolithic contexts. a–b. Mousterian points, c. elongated Mousterian point, d. limace, g–i. Abu Sif knives. *Sources:* Kebara (a), Dederiyeh (b–c), Karaïn (d), Hayonim (e), Hummal Spring αh (f–g). Redrawn after Akazawa and Muhesen (2002), Bar-Yosef and Meignen (2008), Le Tensorer et al. (2007), Meignen (1998), Otte et al. (1995).

Convergent scrapers (Types 18–21) feature retouched edges that form a point. On straight convergent, convex convergent, and concave convergent scrapers, the retouched edges are of roughly equal length. Canted (*déjeté*) scrapers have one retouched edge that is much longer than the other. Many canted scrapers appear square or trapezoidal in plan view, owing to the offset of their technological and morphological axes. The distinction between convergent scrapers and Mousterian points is somewhat arbitrary. Most researchers treat convergently retouched artifacts whose tips meet at relatively low angles (in plan and/or profile) as points and those with higher tip angles as scrapers (Bordes 1961, Debénath and Dibble 1994, Holdaway 1989).

Transverse scrapers (Types 22–24) and endscrapers (Types 25–26) have a single retouched edge located at their distal end. On transverse scrapers, this edge is broad relative to the length of the tool; while on endscrapers, this edge is relatively narrow. Straight, convex, and concave transverse scrapers are recognized on the basis of their edge shape in plan view. Among endscrapers, only typical (symmetrical) and atypical (asymmetrical) forms are distinguished.

Six additional scraper types are defined on the basis of ventral or bifacial retouch or the steepness or the invasiveness of retouch. A scraper on an interior surface (Type 25) is a flake of any shape on which retouch is located on the ventral face of the tool. An abrupt scraper (Type 26) is a simple scraper whose edge is retouched on the dorsal face and is steeply retouched (approximately 90°). A scraper with a thinned back (Type 27) is a double scraper on which the edge opposite the main scraper edge features retouch flake scars invasive past the midpoint of the width. A bifacial scraper (Type 28) preserves retouch on the dorsal and ventral faces of the same edge. An alternate scraper (Type 29) features dorsal retouch on one edge and ventral retouch on another edge. A raclette (Type 39) is a small, thin flake with abrupt, shallowly invasive retouch.

The abundance of scrapers varies widely among Levantine Middle Paleolithic assemblages. Heavily retouched scrapers, transverse scrapers, endscrapers, and scrapers with multiple and convergent edges are rare among Middle Paleolithic assemblages from the East Mediterranean Levant. They are more common among assemblages from the Zagros and Taurus Mountains.

Other Retouched Tools: Denticulates, Notches, Awls, Burins, Truncated-Facetted Pieces

Levantine Middle Paleolithic assemblages contain awls, burins, notches, backed knives, truncations, and denticulates such as those found in Lower Paleolithic assemblages (Figure 4.6.i–q). When they differ from these earlier tool types, it is mainly in being knapped on relatively larger flakes or Levallois core reduction products.

Some of the artifacts in Bordes's typology, such as pieces with bifacial retouch, stemmed points/tools, notched triangles, and

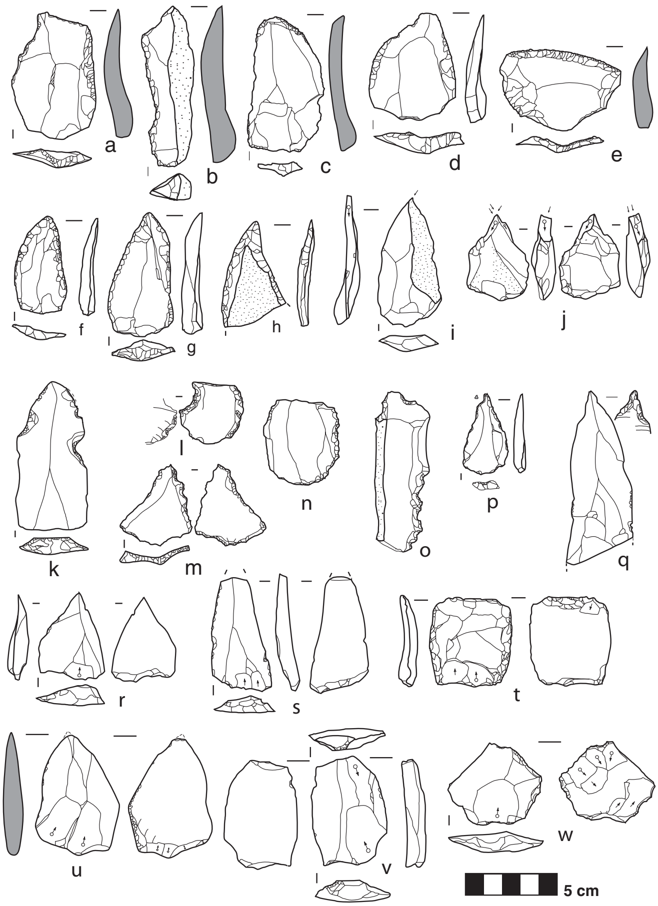


FIGURE 4.6. Middle Paleolithic retouched tools: a–b. sidescrapers, c. endscraper, d. double side scraper, e. transverse scraper, f–h. convergent scrapers, i. simple burin, j. multiple burin, k–l. notches, l–o. denticulates, p–q. awls, r–x. truncated-facetted pieces (r–t. truncation and facetting to impose shape, u–w. cores-on-flakes. Sources: Qafzeh (a–b, d, g–j, r–s), Rosh Ein Mor (c, k–o, q), Ras el-Kelb (e), Dederiyeh (f), Biqat Quneitra (p, t, v–w), Amud (u). Redrawn after Akazawa and Muhesen (2002), Copeland and Moloney (1998), Crew (1976), Goren-Inbar (1990b), Hovers (2004; 2009).

pseudo-microburins are rarely found in Levantine Middle Paleolithic assemblages. Others, such as choppers, chopping tools, and *rabots*, are treated as cores. Pieces with irregular, abrupt, or alternating retouch (Types 45–49) are grouped together in most analyses. Many archaeologists regard the "retouch" in question as the result of trampling or some other post-depositional process.

Truncated-facetted pieces (TFPs) are flakes, blades, or points that have been abruptly truncated along one edge (Nishiaki 1985) (see Figure 4.6.r–w). TFPs are known from virtually every phase of Levantine Stone Age prehistory, but they are especially noteworthy in Middle Paleolithic contexts because they comprise some of the most heavily modified artifacts in these assemblages. TFPs vary widely in size and shape, and thus their identifying criteria are mainly technological, rather than typological. In some cases, their truncation appears to have been part of an effort to reduce the tool's thickness by removing the bulbar eminence or prominent dorsal ridges. In other cases, this truncation was used as a striking platform surface for the detachment of small (often <25 mm long) flakes from either dorsal or ventral surfaces (rarely both). These small flakes may also reflect efforts to thin the tool for prehension or hafting, but it is also possible that they reflect efforts to produce small flakes intended for use. Many typologists are skeptical that flakes so small could be useful, but ethnoarchaeology, experimentation, and microwear analysis of small flakes from Middle Paleolithic contexts suggest this possibility. As with TFPs' overall morphological variability, the flake scars from these removals show no consistent morphological patterning.

Explaining Variation among Retouched Tool Types

There is no strong evidence that particular named Levantine Middle Paleolithic artifact-types had specialized functions (Shea 1991). Some points exhibit wear patterns referable to use as hafted spear points, but these wear patterns are relatively rare and not restricted to any one point type (Shea 1988).

Dibble and Rolland (Dibble 1987, 1995; Rolland 1981; Rolland and Dibble 1990) have proposed that many of the morphological differences among Middle Paleolithic scrapers and some retouched points (e.g., limaces and Mousterian points) reflect greater or lesser amounts of resharpening (see CUP Website Figure 20). Curation by resharpening demonstrably affects morphological variability among scrapers and many other kinds of artifacts in ethnographic, historic, and recent prehistoric contexts. Thus, there is little reason to doubt that the Dibble/Rolland "resharpening" hypothesis captures some significant degree of scraper variation.

Bitumen preserved on stone tools from Umm el Tlel and microwear evidence from other Levantine sites indicate that some Middle Paleolithic stone tools were attached to handles (Boëda et al. 1996, Shea 1988). Similar residue and microwear evidence from Middle Paleolithic/Middle Stone Age sites in Europe and Africa confirm that this practice was widespread in these regions by at least 100–50 Ka. In sharp contrast with the African Middle Stone Age evidence and evidence from Levantine Upper Paleolithic assemblages, however, there are few indications that Levantine Middle Paleolithic stone tools were systematically modified for hafting. One occasionally finds evidence for truncations seemingly intended to conform the tool to a particular size or shape, or to remove bulbar eminences (see Figure 4.6.r–u); but such tools remain minor fractions of the retouched tools in most assemblages.

IV. LEVANTINE MIDDLE PALEOLITHIC INDUSTRIES

Most prehistorians view Levantine Middle Paleolithic assemblages as a regional variant of the larger group of "Mousterian" assemblages found throughout Europe, western Asia, and North Africa. The principal shared features of Mousterian assemblages are that handaxes, cleavers, and other LCTs are rare, the Levallois technique is applied to the production of flakes less than 10–15 cm long, prismatic blades are rare, and scrapers are relatively common (Bordes and Bourgon 1951). Bordian technological and typological indices are often published for Levantine Middle Paleolithic assemblages, but in practice these indices are rarely used to make formal distinctions among assemblage-groups.

The Levantine Mousterian

The taxonomy of Levantine Middle Paleolithic industries is complex. Prior to the 1960s, most investigators referred to Levantine Middle Paleolithic assemblages as "Levalloiso-Mousterian," because Levallois débitage was markedly more common in these assemblages than in European Mousterian assemblages (Table 4.4). During the 1970s–1980s, the term "Levantine Mousterian" came into broader usage, much as it has for Middle Paleolithic assemblages throughout Europe, western Asia, and North Africa.

Table 4.4. *Concordance Among Various Frameworks for Levantine Middle Paleolithic Assemblage-groups*

Reference	Tabun D	Tabun C	Tabun B
Garrod and Bate (1937)	Early Levalloiso-Mousterian	Early Levalloiso-Mousterian	Late Levalloiso-Mousterian
Copeland (1975)	Levalloiso-Mousterian Phase 1	Levalloiso-Mousterian Phase 2	Levalloiso-Mousterian Phase 3
Jelinek (1982a)	Phase 1 Mousterian	Phase 2–3 Mousterian	Phase 2–3 Mousterian
Marks (1992)	Early Levantine Mousterian	Late Levantine Mousterian	Late Levantine Mousterian
Bar-Yosef and Meignen (1992)	Tabun D-Type Mousterian	Tabun C-Type Mousterian	Tabun B-Type Mousterian
This work	Early Levantine Mousterian	Interglacial Levantine Mousterian	Later Levantine Mousterian*

Note: Radiometric dates for Tabun Cave Level B suggest it actually dates to the time period encompassed by the "Interglacial Levantine Mousterian."

Today, most researchers divide the Levantine Middle Paleolithic into a series of either two or three chronostratigraphic phases. The divisions between these phases parallel the chronostratigraphic divisions in Garrod's (1937b) stratigraphy of Tabun Cave. Recent excavations at Tabun (Jelinek 1981, 1982a, 1982b) show its stratigraphy is vastly more complex than Garrod described. Nevertheless, the Tabun Level B-C-D sequence remains a touchstone for models of Levantine Middle Paleolithic chronostratigraphy and variability.

This chapter follows common practice and divides Levantine Middle Paleolithic assemblages into three phases based on their currently understood geochronology: Early Levantine Mousterian (>130 Ka), Interglacial Levantine Mousterian (130–75 Ka), and Later Levantine Mousterian (75–<45 Ka). These Levantine assemblage-groups stand in contrast with their counterparts from the northern Montane part of the Levant. Table 4.5 lists the representative assemblages for each of these assemblage groups.

Table 4.5. *Selected Representative Assemblages for Levantine Mousterian Assemblage-Groups*

Industry	Representative Assemblages
Early Levantine Mousterian	'Ain Difla (WHS 634)
	Abu Sif Levels B–C*
	Azraq surface sites*
	Bezez Cave Level B,
	Douara Cave Level IV
	Hayonim Cave Levels Lower E–F (& G?)
	Hummal 1a
	Jerf Ajla Levels B–F*
	Ksar Akil XXVIIIA–B,
	Misliya Cave Unit II
	Nahal Aqev (D35)
	Rosh Ein Mor (D15)
	Tabun Cave Unit X
	Tabun Level D*
Interglacial Levantine Mousterian	Ar Rasfa
	Douara Cave Level III
	Ksar Akil XXVI–XXVII
	Naamé
	Qafzeh Level L/Units V–XXIV
	Ras el-Kelb Railway Trench A–D and Tunnel Trench J–O
	Skhul Level B*
	Tabun Cave Level C*
	Tabun Cave Unit I Beds 18–26
Later Levantine Mousterian	Amud Cave Level B1–B4
	Dederiyeh
	el Wad Cave Level G*
	Geulah Cave B
	Kebara Cave Units VII–XII,
	Kebara Level F*
	Keoue Cave Units I–III,
	Shukhbah Cave Level D*
	Tabun Cave Level B*
	Tabun Cave Unit I Beds 1–17,
	Tor Faraj Level C,
	Tor Sabiha Level C,
	Umm el Tlel Levels IV 2βa, IV 2γ/δa, and VI 1 a0

(*continued*)

Table 4.5 (*continued*)

Industry	Representative Assemblages
SW Asian Montane Mousterian	Bisitun Cave★ Gar Arjeneh and Gar Kobeh caves★ Hazar Merd Cave★ Karaïn Cave Levels F–I Kunji Cave Level 2 Shanidar Cave Level D★ Warwasi Cave★

Note: ★ Selectively curated. For dating references, see Shea (2003).

Early Levantine Mousterian

Most Early Levantine Mousterian contexts date to between 100 and 245 Ka, in the final interglacial-glacial cycle of the Middle Pleistocene (Marine Isotope Stage [MIS] 7–6) and the earliest part of the last interglacial (MIS 5) (Shea 2003, 2007a). Early Levantine Mousterian core technology is dominated by recurrent unidirectional-parallel and bidirectional-parallel preparation. The resulting débitage includes many Levallois blades and allied laminar artifacts. The most diagnostic artifact-type associated with Early Levantine Mousterian assemblages is the elongated Mousterian point (or "Abu Sif knife"). Endscrapers, burins, and backed knives are common among Early Levantine Mousterian retouched tools. Figure 4.7 shows examples of Early Levantine Mousterian artifacts.

Early Levantine Mousterian sites are known from coastal cave sites (e.g., Tabun, Hayonim) and desert oases (El Kowm/Hummal, Azraq). These sites are also found in the Negev Desert and western Jordan at roughly equivalent latitudes. There is some disagreement over whether "Hummalian" assemblages from El Kowm (Syria) are referable to the Early Levantine Mousterian as well (Le Tensorer 2004, Meignen 2000). Correlated analyses of lithics and fauna from Hayonim Cave suggest relatively high levels of residential mobility (Stiner 2006), but one has to be cautious about projecting similar mobility patterns to all Early Levantine Mousterian occurrences.

Interglacial Levantine Mousterian

Interglacial Levantine Mousterian assemblages date to MIS 5, roughly 71–128 Ka and are thus "interglacial" in the broader sense (i.e.,

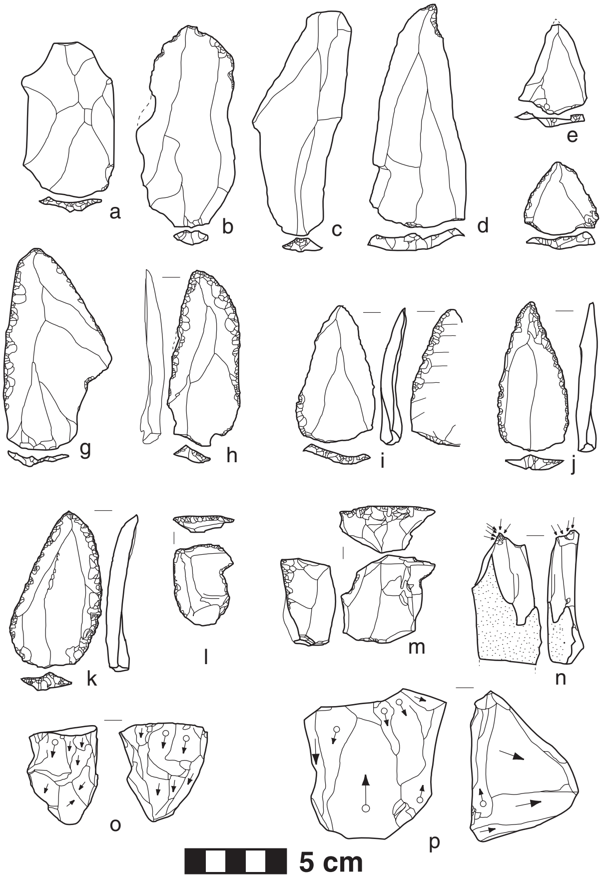


FIGURE 4.7. Early Levantine Mousterian artifacts. a–b. Levallois flakes, c. Levallois blade, d. elongated Levallois point, e–f. Levallois points, g. side scraper, h. convergent scraper, i. Levallois points with ventral retouch, j. Mousterian point, k. convergent scraper, l–m. endscrapers, n. multiple burin, o. prismatic blade core (platform core), p. Levallois core with bidirectional-opposed preparation. *Sources:* Rosh Ein Mor (a–g, l–m, o–p), Nahal Aqev (h–k, n). Redrawn after Crew (1976), Munday (1977).

not restricted to MIS 5e). Among Interglacial Levantine Mousterian assemblages, Levallois technology is dominated by radial-centripetal modes of core surface preparation. The resulting flakes include many large oval and sub-rectangular Levallois flakes and smaller pseudo-Levallois points. Sidescrapers are relatively common among retouched tools. Backed blades, endscrapers, and elongated points are relatively rare. Figure 4.8 shows examples of Interglacial Levantine Mousterian artifacts.

Interglacial Levantine Mousterian assemblages are found mainly in northern Israel, northwestern Jordan, Lebanon, and western Syria. The distribution of these sites along the coast and in the more perennially humid parts of the Levant suggests they were deposited when Mediterranean woodland habitats were restricted to the north-central Levant, more or less as they are today. Interglacial Levantine Mousterian land-use patterns remain poorly known, but traces of fires and preserved burials at several sites (e.g., Qafzeh, Skhul, and Tabun) suggest greater residential stability than seen in nearby Early Levantine Mousterian contexts (Hovers 2009). Interglacial Levantine Mousterian contexts furnish clear evidence for complex symbolic behavior, including shells transported inland from the coast, the use of red ochre, and mortuary structures including grave goods (a boar mandible with Skhul 5 and red deer antler with Qafzeh 11) (see Shea 2007a).

Later Levantine Mousterian

Most reliably dated Later Levantine Mousterian contexts occur between 71–45 Ka, after the sharp turn toward early glacial conditions in MIS 4 and early MIS 3 (Shea 2003). Their core technology emphasizes recurrent and preferential modes of unidirectional-convergent core preparation, with variable frequencies of recurrent radial-centripetal core reduction (Meignen and Bar-Yosef 1992). Both large and small Levallois points, pseudo-Levallois points, blades, and naturally backed knives are common. Width/thickness ratios for whole flakes tend to be high (mean and median values >5.00) (see Jelinek 1982a). Retouched tools vary widely, but in general, simple sidescrapers are relatively common and elongated points, burins, and endscrapers are relatively rare. Figure 4.9 shows examples of Later Levantine Mousterian artifacts.

Later Levantine Mousterian assemblages are known from the full length and breadth of the Levant. Analyses of hearths, faunal remains, phytoliths, and other evidence from Amud, Kebara, and Tor Faraj point toward either decreased residential mobility compared to the Early Levantine Mousterian evidence, or, alternatively, more frequent reoccupation of the same sites at shorter intervals. Possible evidence for over-hunting of gazelle and deer and high proportions of "expedient" cores from Kebara Cave seem to support greater residential stability (Speth and Clark 2006, Wallace and Shea 2006), but as with the Early

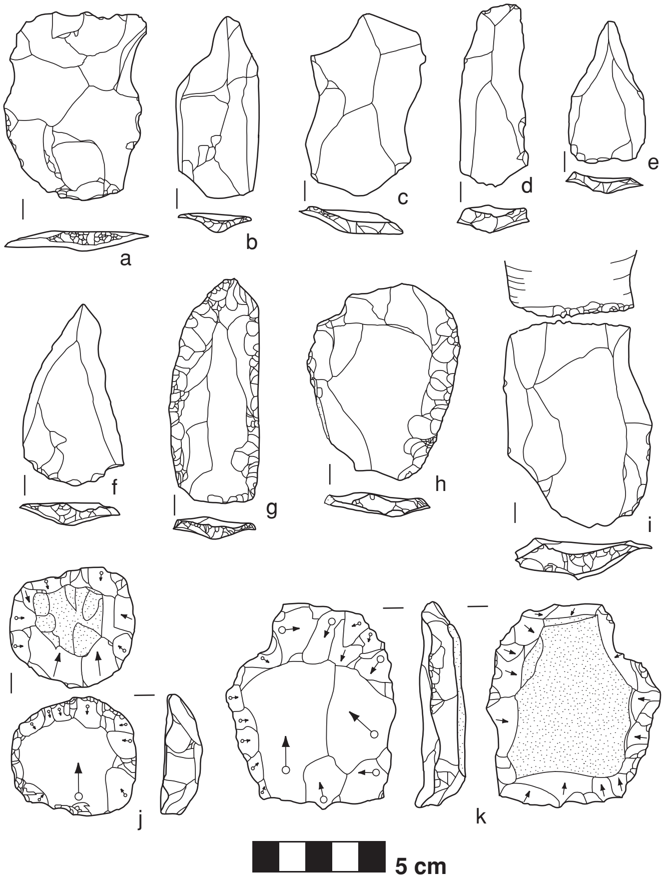


FIGURE 4.8. Interglacial Levantine Mousterian artifacts. a–c. Levallois flakes, d. Levallois blade, e–f. Levallois points, g–h. double scrapers, i. truncation, j–k. Levallois cores with radial-centripetal preparation. Sources: Qafzeh (a–k). Redrawn after Bar-Yosef (2000) and Hovers (2009).

Levantine Mousterian contents of Hayonim Cave, one cannot necessarily extrapolate this inference to all Later Mousterian occurrences.

Other East Mediterranean Middle Paleolithic Assemblages

Not all Middle Paleolithic assemblages from the East Mediterranean Levant can be assigned to one or another of the Early, Interglacial, and Later Levantine Mousterian assemblage groups. In some cases, such as the Mousterian assemblages from Yabrud Shelter 1, Levels 1–9, the ambiguity reflects selective curation and/or relatively small sample sizes. In others, such as Far'ah II, it seems to reflect an assemblage dominated by débitage from early stages of core reduction. Two additional cases, however, suggest that this simple, heuristic framework does not capture the full range of Middle Paleolithic technological and typological variability.

Collections from several Mousterian sites embedded in the red sandstone (*hamra*) deposits along the coast near Mt. Carmel preserve evidence for a nearly "microlithic" Mousterian assemblage. Cores and flakes are very small and retouched tools are rare. The lake-edge site of Biqat Quneitra (Golan Heights) preserves a similarly diminutive flint sub-assemblage, but one in which retouched tools are common. In addition, Biqat Quneitra contains a rich sub-assemblage of large tools made out of basalt (which extrudes near the site). To some degree, the small cores and tools at both sites may reflect local raw material scarcity. The Carmel coast sites would have been located in sand dunes flanked by marshes several kilometers away from Mt. Carmel's flint-rich valleys. At Quneitra, ash and basalt cover flint deposits for more than 10 kilometers in all directions from the site. Differences in the frequency of retouch may also reflect differences in site function and/or occupation history. At the very least, these assemblages show Levantine Middle Paleolithic industrial variability exceeds the scope of the heuristic Early, Interglacial, and Later Levantine Mousterian framework (or indeed, any other framework thus far proposed).

Southwest Asian Montane Mousterian

Middle Paleolithic assemblages from the Montane northern edge of the Levant are often described as "Zagros Mousterian" (Lindly 2005, Otte 2008) (see CUP Website Figures 21–22). Similar assemblages, however, occur more widely into Anatolia, the Caucasus, and the Iranian plateau (Golovanova and Doronichev 2003, Pleurdeau et al. 2007). Therefore, it might be more precise to refer to them collectively as "Southwest Asian Montane Mousterian." Core technology among southwest Asian Montane Middle Paleolithic assemblages is dominated by recurrent discoidal core preparation and reduction. Débitage tends to be relatively short and non-laminar. Retouched tools are common and retouch itself is often steep, deeply invasive, and located on multiple edges of the same tool. Mousterian points (especially elongated

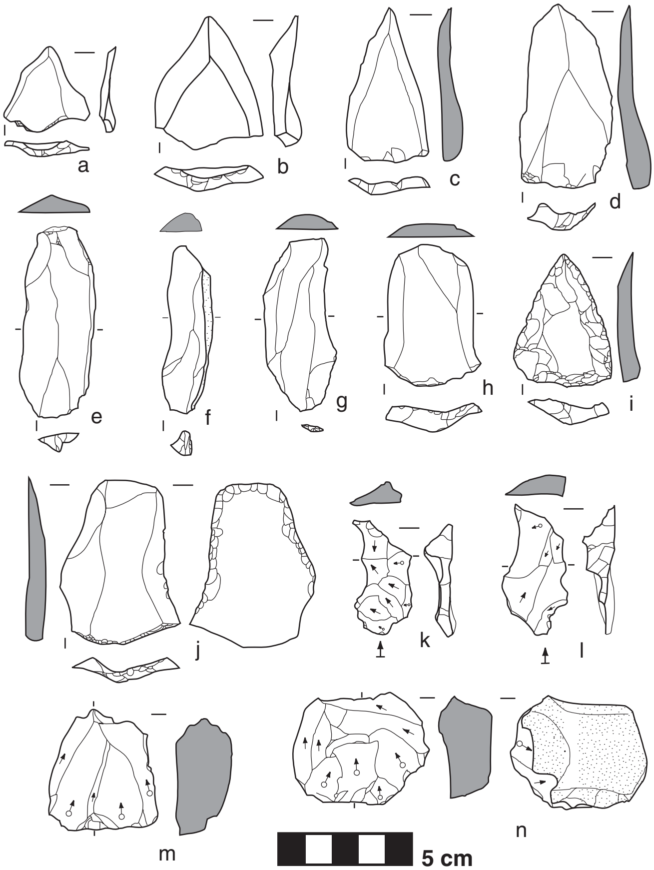


FIGURE 4.9. Later Levantine Mousterian artifacts. a–d. Levallois points, e–f. naturally backed knives, g. Levallois blade, h. Levallois flake, i. Mousterian point/convergent scraper, j. Levallois flake with ventral retouch, k, l. core-trimming elements (with flake scar directionality indicated), m–n. Levallois cores with unidirectional-convergent preparation. *Sources:* Kebara (a–n). Redrawn after Bar-Yosef (2000) and author's notes.

forms), awls, limaces, and canted scrapers are common. Truncations and cores-on-flakes are common.

Many of the differences between East Mediterranean and southwest Asian Montane Mousterian assemblages involve differences in the intensity of core reduction and flake tool retouch. Rolland and Dibble (1990: 490) attribute these differences to varying incentives for tool curation/retouch arising from differences in terrain, resource

Table 4.6. *Relationship Between Resource Structure and Stone Tool Retouch/Curation*

Variable	East Mediterranean Levant	Taurus-Zagros Mountains
Resource structure	Resources dispersed	Resources aggregated
Hominin residential mobility	High, local movements	Low, seasonal movements
Incentives for tool curation and resharpening	Weak	Strong
Tool discard thresholds	Low	High
Heavily-retouched stone tools	Rare	Common

distributions, and hominin raw material provisioning strategies (see Table 4.6).

VII. OVERVIEW AND CONCLUSION

Differences between Lower and Middle Paleolithic

The main differences between the Middle and Lower Paleolithic stone tool technology are decreased numbers of large cutting tools and heavily retouched scrapers and increased use of recurrent and preferential Levallois core reduction to produce large numbers of symmetrical points, blades, and flakes. Middle Paleolithic assemblages exhibit a degree of regional distinctiveness and chronostratigraphic patterning in technology and typology that contrasts with the continental-scale similarities and long-term stability seen among Lower Paleolithic assemblages. Similar kinds of chronostratigraphic patterning continue in later phases of Levantine prehistory, albeit at successively shorter timescales.

The principal ways in which the Levantine Middle Paleolithic stone tool evidence differs from that in adjacent regions is that it lacks the foliate bifaces and tanged points found in North African assemblages after 100 Ka. It also lacks the emphasis on the production of large and heavily retouched core-tools and scrapers seen among Middle Paleolithic assemblages in western Eurasia.

How to Improve the Middle Paleolithic Lithic Evidence

What could one do to improve the value of the Levantine Middle Paleolithic stone tool record for research into human evolution? Two changes are obvious. First, keystone sites need to be published. Second, some kind of unified chronostratigraphic framework needs to be adopted for the region. A third change, abandoning Bordian typology, might help, but it is not essential.

Any effort to synthesize the Levantine Middle Paleolithic lithic evidence confronts the problem that many important sites, some excavated decades ago, have not seen definitive monographic publication (e.g., Tabun, Kebara, Amud, Hayonim, and Shanidar). To be fair, many of these sites were the focus of complex, multidisciplinary excavations, and coordinating the activities of the many scholars involved in such projects is a difficult and unenviable task. On the other hand, there are enough examples of Levantine Middle Paleolithic sites excavated and published promptly to furnish counter-examples (e.g., Biqat Quneitra, Dederiyeh, Sefunim, and Tor Faraj). Finding a structural solution to the problem of delayed publication is a pressing concern, but one beyond the scope of the present work.

At present, there are several competing chronostratigraphic frameworks for describing the Middle Paleolithic lithic evidence. Most of these are based on Garrod's stratigraphy of Tabun Cave, or extrapolated from it. These frameworks need to be retired. The time has long since passed when one site, no matter how thoroughly researched can serve as the "type site" for an entire region. Similarly, it is highly counterintuitive that technological or typological characteristics of lithic assemblages vary in the same way consistently over time and across the entire region. In place of these frameworks, this chapter has proposed a framework recognizing Early, Interglacial, and Later Middle Paleolithic Periods. The divisions between these periods correspond to major shifts in the marine oxygen-isotope scale that, in theory, ought to be correlated with shifts in terrestrial conditions in the Levant and to changes in hominin/human adaptation.

Finally, there seems little compelling reason to continue using Bordian typology to describe Levantine Middle Paleolithic assemblages (Bisson 2000). Most of the major taxonomic distinctions among

Middle Paleolithic assemblages from the Near East revolve around contrasts in core technology and in gross frequencies of artifacts in broadly defined categories. In contrast, most of the distinctions among artifacts made in Bordes's (1961) typology focus on subtle differences among specific kinds of heavily retouched points and scrapers. Neither of these artifacts, however, is especially common among assemblages from the East Mediterranean Levant. These artifacts are common enough in the Montane Levant, so retaining them there might have some value for comparisons with adjacent parts of Europe.

5

THE UPPER PALEOLITHIC

I. INTRODUCTION

Throughout western Eurasia, the early Upper Paleolithic Period (ca. 45–28 Ka cal. BP) witnessed the replacement of Neanderthals and other indigenous populations by *Homo sapiens*. *Homo sapiens* fossils appear in Europe for the first time after 36 Ka, but in the Levant it remains unclear whether Upper Paleolithic *Homo sapiens* are descended from Middle Paleolithic *Homo sapiens*, or if their presence reflects dispersal from Africa and/or southern Asia. The later Upper Paleolithic (ca. 28/25–11/8 Ka cal. BP) in Europe corresponds roughly to the Epipaleolithic Period in the Levant.

In the Levant, the Upper Paleolithic Period dates to 47–22 Ka cal. BP (Belfer-Cohen and Goring-Morris 2003). This was a period of cool but widely variable climate, between the abrupt shift to colder temperatures during MIS 4 (63–74 Ka) and the further downturn in temperatures during the Last Glacial Maximum/MIS 2 (18–32 Ka cal. BP) (Bar-Matthews and Ayalon 2003, Burroughs 2005). Colder temperatures (and presumably greater cloud cover) suppressed evaporation rates, and the Lisan Lake expanded across much of the Jordan Rift Valley. Playa lakes formed at higher elevations in Syria, Jordan, and southern Israel/Sinai (Horowitz 1979).

Upper Paleolithic Human Behavioral Evolution

For many prehistorians, the Upper Paleolithic marks the first time in which the archaeological record begins to resemble the record associated with recent human hunter-gatherers (Dennell 1983). There is evidence for a wide ecological niche, one encompassing specialized big game hunting as well as fishing and systematic collection of smaller game. Human occupation extends permanently into harsh tundra and desert habitats that earlier hominins largely avoided. Technology includes complex, multicomponent tools, including projectile weapons and artificial shelters, pyrotechnology (thermal alteration of flint, ceramic production), carved bone tools, and symbolic artifacts. The latter include media, similar to those used by Middle Paleolithic humans, such as mineral pigments and personal adornments, but they also include realistic and abstract sculpture and notation systems, all of which vary in the short term and in the same kind of highly reticulated patterns one sees among ethnographic human material culture. This, in addition to similarly patterned variation in artifact styles and production techniques and raw material transfers over tens of kilometers, suggests regional populations were becoming more interconnected ("networked") with one another (Gamble 2007, Stiner and Kuhn 2006).

In older literature, the Upper Paleolithic is often portrayed as a universal stage of human bio-cultural evolution, a "Human Revolution" dividing earlier "archaic" *H. sapiens* from their "modern" counterparts (Mellars 1989). This vision of the Upper Paleolithic is no longer strongly supported, at least not on a global scale (Mellars 2007). Many of the derived behavioral characteristics of the Eurasian Upper Paleolithic are documented in African and Asian contexts dating prior to 45 Ka (McBrearty 2007, McBrearty and Brooks 2000, Shea 2011b). The Levantine Upper Paleolithic differs from the periods before it, but there is little consensus among prehistorians about the nature of those differences or their ultimate causes (Bar-Yosef 2002, Shea 2011a, 2011d).

The Upper Paleolithic Archaeological Record

The archaeological record for the Levantine Upper Paleolithic is informed by research at several dozen well-excavated and well-documented sites. The most important of these, from the standpoint of lithic systematics are listed in Table 5.1 and plotted on Figure 5.1. More so than for the Middle Paleolithic, more of these sites are open-air sites

Table 5.1. *Important Upper Paleolithic Sites Together with Key Bibliographic References*

Site Name and Levels	Key References
Abu Noshra I, II, IV, VI	Phillips (1988)
Ain el Buhira (WHS 618C)	Coinman (2000a)
Arqov/Avdat (Ain Aqev/Boker C)	Marks and Ferring (1976)
Anteilas	Copeland (1970)
Azariq IV, XIII	Goring-Morris (1987: 63)
Azraq 17	Byrd (1988)
Boker A, Boker BE Levels I–III. Boker C	Marks (1983a), Jones et al. (1983)
Boker Tachtit Levels 1–4	Marks (1983a, Marks and Kaufman 1983)
Ein Aqev (D31) Levels 5–12	Marks (1976a)
Ein Aqev East	Ferring (1977)
Ein Avdat Area, Sites D14, D18, D20, D21, D22, D26, D27A, D28, D29, D100A&B	Marks and Ferring (1976)
Ein Qadis	Goring-Morris (1995a)
El Khiam Rockshelter Units E–F (Levels 9–10)	Echegaray (1964, Echegaray and Freeman 1989)
El Wad Cave Levels C–G	Garrod and Bate (1937)
El-Quseir	Perrot (1955)
Emireh Cave	Garrod (1955)
Erq el-Ahmar Rockshelter Units B–F	Neuville (1951), Phillips and Saca (2002)
Et Tabban Rockshelter Level B	Neuville (1951)
Fazael IX	Goring-Morris (1980)
Har Harif G11 & K9A	Marks and Larson (1977)
Har Horesha I	Belfer-Cohen and Goring-Morris (1986)
Hayonim Cave Level D	Belfer-Cohen and Bar-Yosef (1981)
Jebel Humeima	Kerry (1997)
Jilat 9	Garrard et al. (1988)
Kebara Cave D-E/Units I-IV	Ziffer (1978)
Ksar Akil Rockshelter Levels 6–25	Azoury (1986), Bergman (1987), Ohnuma (1989)
Lagama Sites V–VIII, X–XII, XV–XVI	Bar-Yosef and Phillips (1977)
Madamagh	Schyle and Uerpmann (1988)
Masraq e-Na'aj	Perrot (1955)
Meged Rockshelter	Kuhn et al. (2004)
Nahal Ein Gev I	Belfer-Cohen et al. (2004)
Nahal Nizzana XIII	Goring-Morris and Davidzon (2006)
Ohalo II	Nadel (2002)

(continued)

Table 5.1. (*continued*)

Site Name and Levels	Key References
Qadesh Barnea Sites 602, 601A, 601B, 501, 9A, 9B, 9C	Gilead (1981)
Qafzeh Cave Units E/D/Levels 8–9	Bar-Yosef and Belfer-Cohen (2004)
Qseimeh Sites I, II and III	Gilead and Bar-Yosef (1993)
Ramat Matred I	Gilead (1981)
Raqefet Cave Units III–VIII	Lengyel (2007)
Sde Divshon (D27B)	Ferring (1976)
Sefunim Cave Levels B–D	Ronen (1984)
Shunera XV, XVI	Goring-Morris (1987: 63)
Sinai Site A306a	Gilead (1984)
Thalab al-Buhira Levels E, C	Coinman (2000b)
Tor Aeid (J432)	Williams (1997)
Tor Fawwaz	Kerry and Henry (2003)
Tor Hamar (J431)	Coinman and Henry (1995)
Tor Sadaf Rockshelter Units I–III	Coinman and Fox (2000)
Üçağızlı Cave Units B–I	Kuhn et al. (2009)
Umm el Tlel Units I–III	Ploux and Soriano (2003), Ziffer (1978)
Uwainid 18 (Lower)	Garrard et al. (1988)
Yabrud Rockshelter II Levels 1–6	Pastoors, Weniger, and Kegler (2008)
Yutil al Hasa (WHS 784)	Olszewski et al. (2000)
Wadi Hammeh Sites 32, 34	Edwards et al. (1988)
Wadi Sudr (Sinai) Sites 1–6	Baruch and Bar-Yosef (1986)

discovered by intensive surveys in the Sinai Peninsula (Bar-Yosef and Phillips 1977), Negev Desert (Marks 1981), and in western and southern Jordan (Coinman 1998, Henry 1995c). The most recent overviews of this period include works by Belfer-Cohen and Goring-Morris (2003) and Bar-Yosef and Belfer-Cohen (2010).

The Upper Paleolithic evidence from the East Mediterranean Levant differs somewhat from that found in the Montane northern Levant (Düring 2011), but the differences are less marked and there are enough similarities to justify including this latter evidence in this chapter.

Upper Paleolithic Lithic References

There are several type-lists currently in use for describing Levantine Upper Paleolithic stone tools. Most are derived from a typology

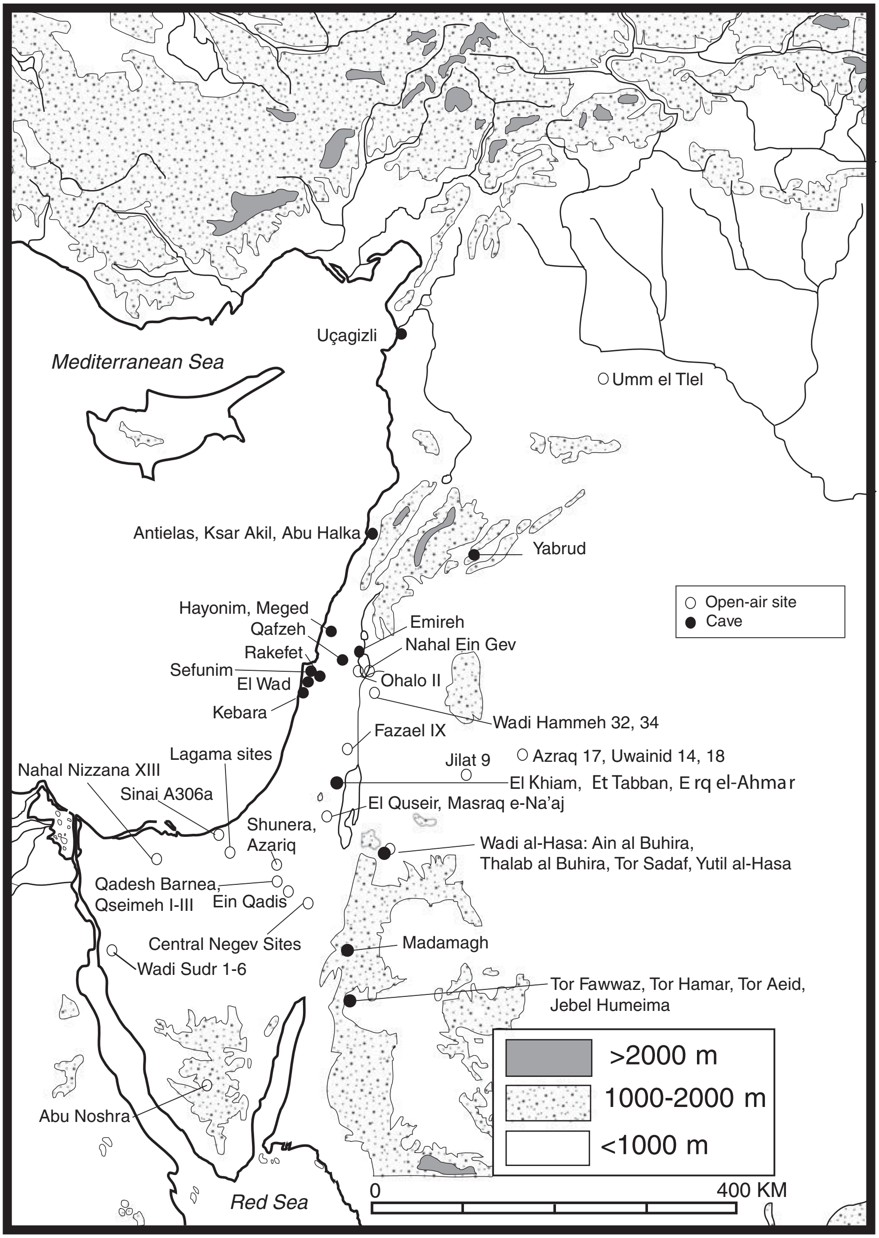


FIGURE 5.1. Map showing important Upper Paleolithic sites. Note: "Central Negev Sites" include Arqov, Boker A, BE, C, Boker Tachtit, Ein Aqev, Ein Avdat, Har Horesha, Har Harif, Ramat Matred, and Sde Divshon.

originally developed for the West European Upper Paleolithic by D. de Sonneville-Bordes and J. Perrot (1954, 1955, 1956). The 1969 London Symposium attempted to standardize the various typologies then in use for the Upper Paleolithic and Epipaleolithic of the Levant (Hours 1974). Two lists resulted: one for use in describing assemblages viewed as "transitional" between Middle and Upper Paleolithic, the other intended primarily for descriptions of Upper Paleolithic and Epipaleolithic assemblages (hereafter the London Typologies). Appendix 1 presents a synthesis of the London typologies for Upper Paleolithic and Epipaleolithic Periods.

II. UPPER PALEOLITHIC CORE TECHNOLOGY

Levantine Upper Paleolithic core technology differs from Middle Paleolithic precursors by showing increased emphasis on "volumetric" prismatic blade core reduction. As discussed in Chapter 4, volumetric blade production differs from that seen among pebble-core and Levallois core reduction in that the high mediolateral arch of the core's flake-release surface enables a knapper to exploit very nearly the entire volume of the core.

Prismatic Blade Core Technology

Prismatic blade cores are the most distinctive and "derived" aspects of Upper Paleolithic core technology. Prismatic blade cores have a series of elongated rectangular or elongated triangular flakes detached from them. The term "prismatic" refers to the long, flat flake scars that occur on blades and cores produced by this mode of core reduction. These blades are detached contiguously, with the flake scar ridge left at the margin of a previous detachment, serving as the guiding midline flake of the next removal. Transversely, the flake-release surface describes a high arch that is maintained by sequential flake removals. This flake-release surface and contiguous striking platform of a prismatic blade core approximates the shape of a cone or a cylinder that has been bisected along its long axis (see Figure 5.2). The striking platform surface of a prismatic blade core can be planar or facetted, but it is rarely cortical. The shape of the remainder of a prismatic blade core depends on the nature of the raw material from which it is made, and the extent to which it has been reduced, as well as other

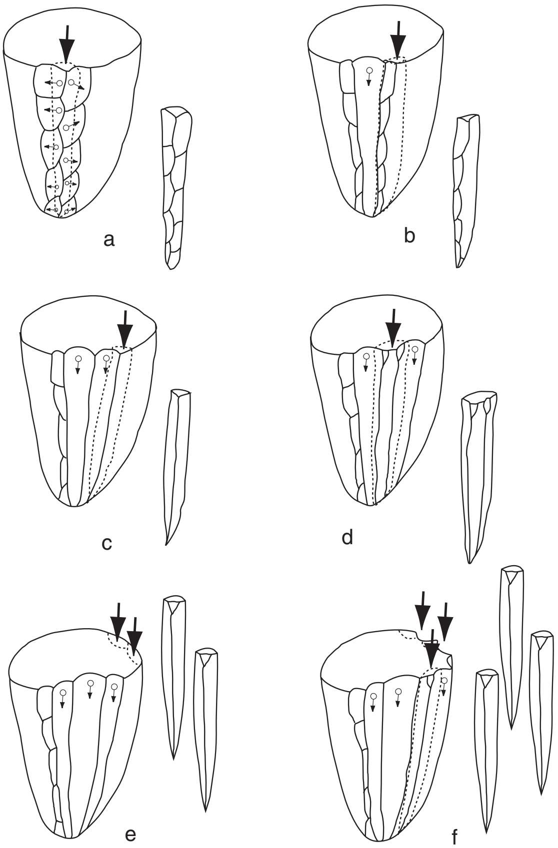


FIGURE 5.2. Schematic diagram of prismatic blade core reduction (after Jacques Bordaz 1970: 53, Figure 20). a. removal of crested blade, b. removal of "guiding" blade, c–f. prismatic blade removals.

factors. In general, prismatic blade cores are elongated in parallel with the principal flake-release surface, but this quality varies. The edges of the striking platform surface on prismatic blade cores were often abraded prior to flake detachment. This appears to have been done to prevent striking platform collapse/edge-crushing. Traces of this abrasive wear can often be seen on the striking platforms of detached flakes.

Mechanics of Prismatic Blade Production

Systematic blade production requires the knapper to control fracture propagation over a narrow, expanding front for a relatively long distance. The risk in this method of flake production is that bending forces on the blade during fracture propagation can cause it to break prematurely, requiring extensive further knapping to restore the functionality of the release surface.

There are several things a flintknapper can do to reduce the risks of such breakage. First, flintknappers can select homogeneous and fine-grained raw materials. Such materials minimize the chances that the expanding fracture front will encounter bending forces perpendicular to the plane of fracture propagation. Second, flintknappers can concentrate the load applied onto the minimum area of core striking platform surface. This can be accomplished either by striking the core with the narrow tip of an elongated hammerstone or by indirect percussion with a bone or antler punch.

Many textbooks and popular reconstructions show Upper Paleolithic humans making blades by indirect percussion. Antler punches recovered from European Upper Paleolithic contexts affirm the antiquity of this practice (one also known from ethnographic contexts). Nevertheless, a competent knapper can make prismatic blades by direct percussion, either with a stone or a bone/antler hammer. Blades can also be detached by pressure, but most prehistorians view direct or indirect percussion as the mainstays of Upper Paleolithic prismatic blade core technology.

One of the most notable aspects of prismatic blade core technology is its efficiency. Once a knapper has set up the core's striking platform and flake-release surfaces, and barring major errors, the resulting débitage contains little other than blades, microdébitage, and the occasional core-rejuvenation flake.

Blade Cores

Upper Paleolithic blade cores are classified in terms of the number and alignment of striking platform surfaces. The major divisions of these cores are between single-platform cores and various kinds of multiple-platform cores (see Figure 5.3).

Single-platform blade cores feature a flake-release surface in which all flake scars originate in the same cardinal direction. Smaller examples of such cores frequently show a more recent series of shorter blade removals overlying the proximal ends of longer flake scars left by

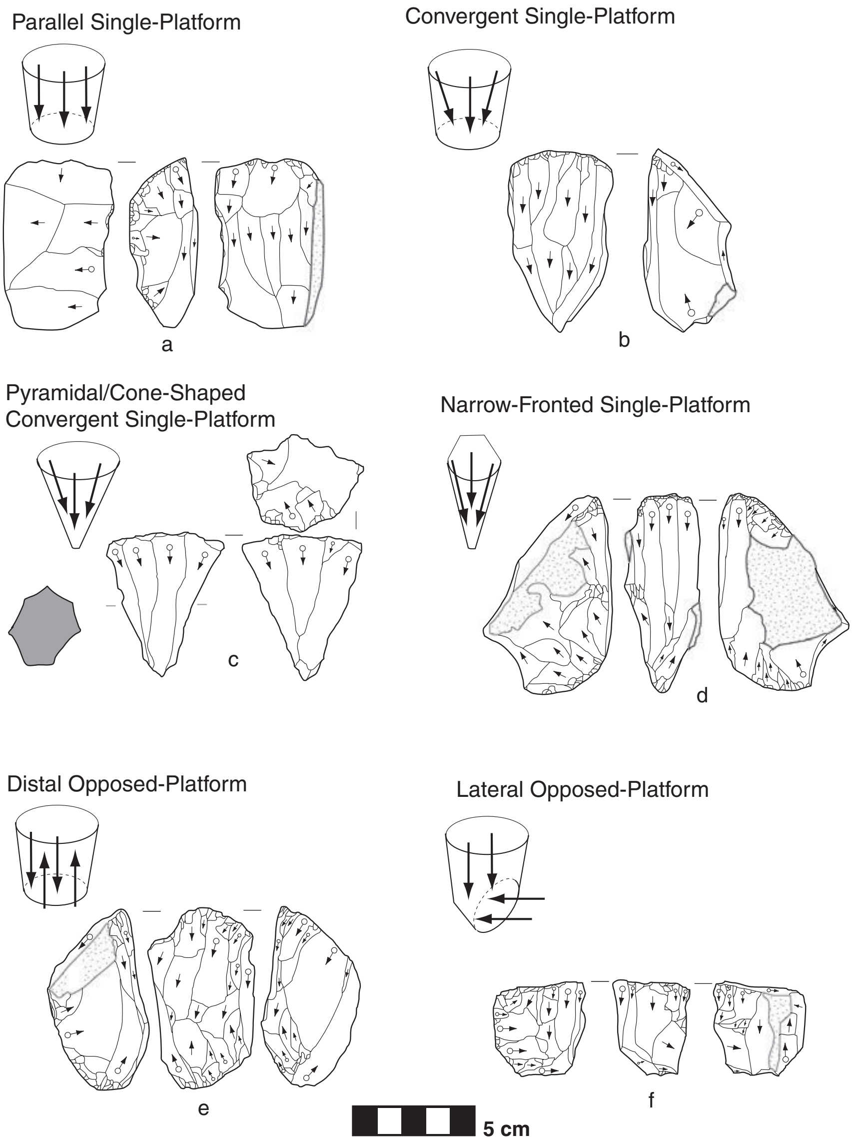


FIGURE 5.3. Upper Paleolithic prismatic blade cores. a. parallel single platform blade core, b. convergent single platform blade core, c. pyramidal/conical single platform blade core, d. narrow-fronted single platform blade core, e. distal-opposed platform blade core, f. lateral-opposed platform blade core. *Sources:* Sde Divshon (a, b, d), Ksar Akil Level XXII (c), Ein Aqev East (e), SMU Ein Avdat/D14 (f). Redrawn after Azoury (1986), Ferring (1976; 1977).

previous blade removals. Most core typologies distinguish single-platform cores on which scar directionality on the flake-release surface is parallel and those on which it is convergent toward the distal end of the core (parallel and convergent single platform blade cores, respectively). Among the latter, there are two generally recognized types. "Pyramidal" cores are cone-shaped, single-platform blade cores with a striking platform that makes a complete circle about the core's medi-olateral circumference. "Narrow-fronted" cores have striking platform surfaces and flake-release surfaces that together approximate a long, narrow half-cone on a relatively long and narrow piece of stone (either a large flake or a tabular block). Their narrow-front makes these cores particularly effective sources of pointed bladelets.

There are two main types of opposed-platform blade cores. On distal opposed-platform blade cores, the two striking platform surfaces are aligned in direct (0°–180°) opposition to one another on the same face of the core. On lateral opposed platform blade cores, the two platform surfaces are aligned more or less at right angles to one another.

Other varieties of multiple-platform blade cores including ones with more than two separate striking platforms and cores with non-overlapping flake-release surfaces on different sides of the core. The identification and naming of these multiple-platform cores is not consistent. Unless there is a compelling reason to distinguish among them, most can be grouped together in a "miscellaneous" category.

Carinated Pieces & Multiple Burins: Cores or Retouched Tools?

Certain Upper Paleolithic artifacts simultaneously fit the definitions of cores and retouched tools. The most obvious examples of these are "carinated pieces," which can include carinated scrapers and multiple burins (discussed in a later section, among retouched tools). When the flake scars on these artifacts are not laminar, they are treated as retouched tools. When they feature parallel sets of short (<30 mm long) and narrow flake scars, which suggest they may have been created in the course of microblade production, some typologists treat them as cores. Increasingly, typologists group all such artifacts together as "carinated pieces," a morphological type with no overt implications about whether they were cores, retouched tools, or both.

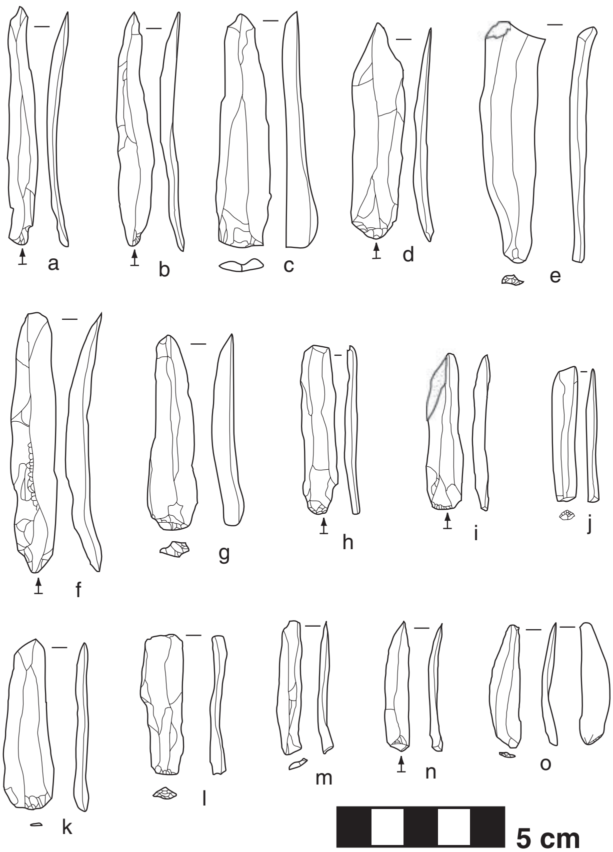


FIGURE 5.4. Upper Paleolithic blades and bladelets. a–g. blades, h–n. bladelets, o. "twisted" bladelet. *Sources:* Ksar Akil Level XVII (a–d, h–j), Ksar Akil Level XVI (e, k–l), Ksar Akil Level XVIII (f–g, m–n), Boker Tachit Level 1 (o). Redrawn after Marks (1983a), Ohnuma (1989).

Flakes Produced by Prismatic Blade Core Technology

The principal flake byproducts of prismatic blade core technology include the blades themselves, core preparation flakes, and core rejuvenation flakes.

Types of Blades (Blades/Bladelets/Microblades)

Archaeologists define blades as elongated flakes whose length is at least twice their maximum width (see Figure 5.4). Blades are rectangular or elongated and triangular in overall plan shape, although their distal end can be rounded, pointed, squared or skewed. "Prismatic" blades are blades with roughly parallel lateral edges, dorsal flake scar ridges aligned with the blade's technological long axis, and roughly triangular or trapezoidal cross sections. Two subsets of prismatic blades are further distinguished: bladelets and microblades. Bladelets are less than 50 mm long and between 10–15 mm wide. Microblades are less than 50 mm long but no wider than 9 mm. There is no upper limit on the size of a blade, although few Upper Paleolithic blades are more than 20 cm long.

Some Levantine prehistorians differentiate between pointed and rounded- or square-ended blades, but this practice is not consistent. Most Levantine prehistorians also distinguish bladelets and micro-blades that are relatively flat in profile from those with pronounced ventral curvature and/or those whose ventral planes twist laterally. These curved and twisted bladelets can result from the reduction of carinated pieces.

Primary Elements/Core-Preparation Flakes

The cortical flakes and flake fragments detached during the initial phases of prismatic blade core preparation are classified as primary elements or core-preparation flakes. Although they are a necessary part of prismatic blade core production, it can be difficult to relate such primary elements specifically to prismatic blade core preparation other than by artifact-refitting studies.

Crested blades are specifically referable to the prismatic blade core preparation. The success of prismatic blade core reduction depends on fractures propagating under a relatively high-arched segment of the flake-release surface. A flintknapper can ensure the removal of the longest, straightest blades possible by detaching the first blade under a guiding ridge, or "crest" (Figure 5.5.a–d and CUP Website Figure 23). The crest is a part of the core where two surfaces converge at an acute angle. Alternatively, it can be a unifacially or bifacially modified edge. Detaching the first blade under this ridge creates a long straight flake scar whose lateral margins can be the central ridges of subsequent blade removals. The blade detached under this guiding ridge is called a crested blade because it is thick in cross section and the ridge is preserved on its dorsal surface. Following the removal of the crested

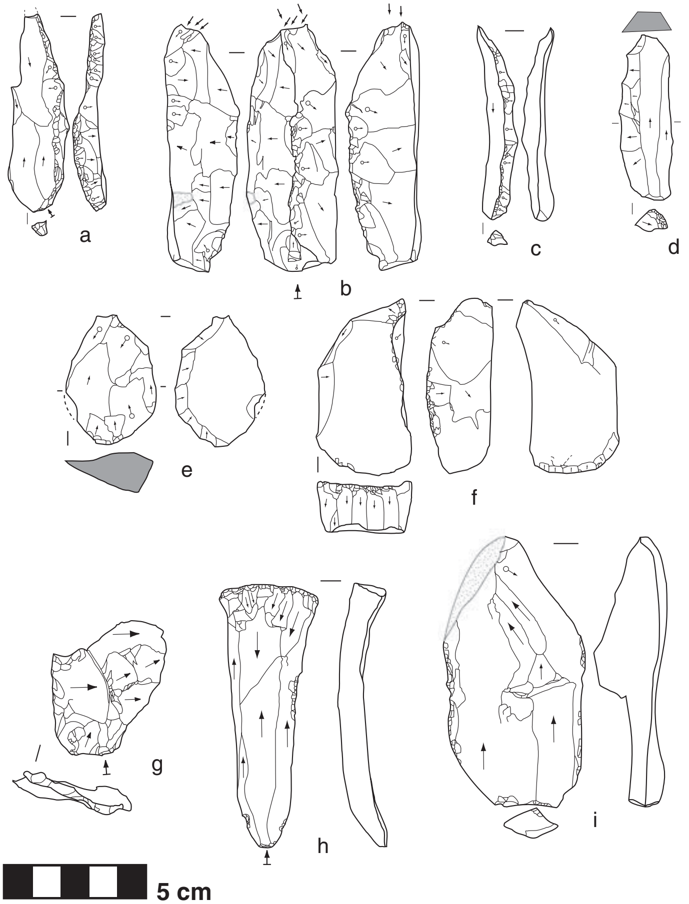


FIGURE 5.5. Upper Paleolithic blade core preparation and rejuvenation flakes. a. asymmetrical crested blade, b. crested blade with multiple burin scars at distal end, c. crested blade, d. secondary crested blade, e–f. core tablet flakes, g. lateral core-trimming flake, h. plunging blade, i. plunging flake. *Sources:* Boker Tachtit Level 1 (a), Boker Tachtit Level 2 (b), Ksar Akil Level XXII (c–d), Ksar Akil Level XXI (e), Boker Area A (f), Ksar Akil Level X (g), Boker Tachtit Level 1 (h) Boker Tachtit Level 4 (i). Redrawn after Bergman (1987), Marks (1983a; 1977b), Ohnuma (1989).

blade, one or more "guiding blades" are often struck to remove the distal ends of the flake scars that comprised the crest and to create a straight ridge that guides subsequent blade removals. Crested blades are relatively thick and either triangular or trapezoidal in cross section. Although the crest often follows the distal-proximal axis of the flake, it can be positioned asymmetrically. “Secondary” crested blades are blades detached under the flake scar left by the detachment of the “primary” crested blade. The latter can be identified by flake scars radiating laterally away from the centerline of the core.

Core-Rejuvenation/Core-Trimming Elements

As a prismatic blade core is reduced, the knapper faces two problems, platform retreat and short termination. Platform retreat develops when the bulbar eminences of successive flake removals cause the flake-release surface to retreat faster nearer the striking platform than on more medial or distal parts of the release surface (CUP Website Figure 24). Eventually, the angle formed by the intersection of the striking platform surface and the flake-release surface approaches 90°, and it becomes difficult to detach further blades from that edge. Upper Paleolithic knappers often solved this problem by striking a flake that undercuts the striking platform surface, changing the angle at which that surface and the flake-release surface intersect one another. Such a “core tablet flake” is detached from the margins of the flake-release surface and more or less perpendicular to the flake-release surface (Figure 5.5.e–f). Core tablet flakes can be identified by the remnant former steep core edge at on their dorsal surface.

Short termination happens when blades do not propagate the full length of the flake-release surface (CUP Website Figure 25). When this occurs, the convexity at the distal end of the flake-release surface causes successive blade removals to terminate ever closer to the striking platform surface. This results in progressively shorter blades with step and hinge terminations. Prehistoric knappers often solved this problem by initiating flakes from the distal and lateral edges of the flake-release surface so that they undercut and remove the distal convexity. The resulting “distal core-trimming elements” can be identified by the presence of distal hinge- and/or step-terminated flake scars on their dorsal surface (Figure 5.5.g–i). These dorsal flake scars are aligned either roughly orthogonally (90° or 270°) or in direct opposition (180°) to the axis of flake propagation. Attempts to undercut distal convexities by a flake directed along the same axis as previous blade removals often results in fracture that hinges down into the core, detaching a “plunging blade.” A form of overshot flake, plunging blades have their thickest point near their distal end. Novice knappers often detach plunging blades when learning indirect percussion, but with practice, competent knappers can deliberately induce plunging blades in order to rejuvenate a prismatic blade core.

III. UPPER PALEOLITHIC RETOUCHED TOOLS

Retouched tools from Upper Paleolithic assemblages can be discussed in terms of four major groups of artifacts: endscrapers, burins, typologically significant retouched tools, and "common" retouched tools. Typologically significant retouched tools are artifact-types that are particularly important in archaeological models of Levantine Upper Paleolithic variability. Common retouched tools are tools that play no significant role in higher-order systematics. Levantine Upper Paleolithic assemblages also feature a small number of groundstone tools.

Endscrapers

Endscrapers have at least one retouched edge located at their distal end. This retouched end is most often convex in plan view. Most of the differences among named endscraper types involve the overall shape of the tool and the number of retouched edges (see Table 5.2, Figure 5.6, and CUP Website Figure 26). In describing endscrapers, a distinction is drawn between "regular" endscrapers (Types 32–43) and "carinated" endscrapers (Types 44–51). Regular endscrapers have retouched edges that are acute in profile view. Carinated ("nosed") endscrapers have a steeply convergent retouched edge on which flake scars are laminar and distally convergent. The retouched edge is plano-convex in lateral profile and highly convex in its transverse profile. Levantine archaeologists often group carinated endscrapers together with carinated pieces, recognizing some of these carinated endscrapers may actually be bladelet cores or a tool that combines core and scraper functions.

Most endscrapers are thought to have been used in orthogonal cutting motions (scraping) on the retouched edge that defines them. Wear referable to hide-scraping is common on endscrapers from Europe (Juel Jensen 1988), but there is little comparable microwear evidence from the Levant.

Table 5.2. *Definitions of Upper Paleolithic Endscraper Types*

Type Name	Definition
Single endscraper	Blade or flake with a single continuous, non-abrupt, retouch on one end. Retouched distal edge is convex, rectilinear, or oblique.
Atypical endscraper	Single endscraper with irregular retouch.
Double flat endscraper	Blade or flake, with or without lateral retouch, featuring two retouched edges at the distal and proximal end. Retouch on dorsal face only.
Alternate flat endscraper	Double flat endscraper but with retouch on dorsal and ventral faces.
Ogival endscraper	Endscraper on a blade or flake, with a working edge formed by the convergence of two slightly convex lateral edges.
Endscraper on retouched blade	Endscraper on a blade with continuous retouch on one or both lateral edges.
Endscraper on Aurignacian blade	Endscraper on a large, thick blade with invasive scalar retouch on the lateral edges.
Fan-shaped endscraper	Short endscraper with a semicircular face. Distal edge is broad, sometimes with bladelet retouch. The base is narrow and sometimes retouched.
Flake scraper	Endscraper on a large, thick blade with invasive scalar retouch on the lateral edges.
Endscraper on a Levallois point	Triangular flake with a retouched distal end.
Circular (end)scraper	Scraper on a broad flake with variable dimensions. The working edge frequently extends along the entire circumference, except the striking platform.
Thumbnail endscraper	Short endscraper with a broad convex edge, narrow base.
Carinated endscraper	Endscraper on a thick flake, whose shallowly convex sides converge to a sharp point. The working edge is defined by bladelet removals, which can be broad and short, or narrow and long.
Atypical carinated endscraper	Carinated endscraper whose removal scars are broad and not in the form of bladelets, or the profile is irregularly shaped.
Lateral carinated endscraper	Carinated endscraper whose flake-release surface is located on the lateral margin of a flake.

Type Name	Definition
Thick-nosed endscraper	Endscraper on a blade or thick flake on which the working edge is generally characterized by bladelet retouch. The "muzzled" working edge has a thick triangular, quadrihedral, or pentagonal cross section.
Flat-nosed or shouldered endscraper	Endscraper on a blade or thin flake on which the working edge is characterized by a projection defined by retouch on both edges (muzzled), or on one only (shouldered).
Micro-carinated endscraper	Relatively small (<20 mm long or thick) carinated endscraper.
Multiple carinated endscraper	Carinated endscraper with multiple flake-release surfaces.
Thick endscraper on a core ("rabot").	Endscraper arranged on a core by regularization of retouch along one sector of the core's striking platform surface.

Burins

Upper Paleolithic burins differ from those found in earlier contexts less so in kind than in their collective pattern of variation. They are more often made on blades and are overall more symmetrical and more extensively modified. The burin scars on Upper Paleolithic burins are usually at least 5 mm long, aligned more or less parallel to the long axis of the tool, and run to at least 10 percent of the tool's length. Table 5.3 lists the major Upper Paleolithic burin types (see also Figure 5.7.a–p and CUP Website Figure 27). Most of the typological distinctions among burins are based on their overall shape, the number and orientation of burin scars, and other variables. The four major groups of burins are dihedral burins (Types 52–56), carinated burins (Types 57–59), burins on truncations (Types 60–67), and multiple burins (Types 68–69).

The use of the term, *burin* (French for "engraving tool"), reflects early prehistorians' belief that burins' narrow tips were used for carving hard materials, such as bone or wood. Further study has revealed more variable functions. Microwear analysis reveals abrasive wear on the tips of burins as well as on the edges (Juel Jensen 1988). Wear on the dorsal ridges of burin flakes further suggests that in some cases

Table 5.3. *Definitions of Upper Paleolithic Burin Types*

Type Name	Definition
Straight dihedral burin	A burin with two burin removals or groups of removals that have a roughly equal obliquity to the central/long axis of the tool.
Offset dihedral burin	A dihedral burin on which one of the removals, or groups of removals, is aligned more obliquely than the other is to the central/long axis of the tool.
Angle dihedral burin	A dihedral burin on which one of the removals (or groups of removals) is parallel to and the other perpendicular to the central/long axis of the tool.
Angle dihedral burin on break	A burin on which one removal or groups of removals is/are parallel to the central/long axis of the piece and the other is formed by a bending fracture surface.
Multiple dihedral burin	A burin combining more than one burin form of the kinds described by Types 52–56.
Beaked burin	A multiple burin whose striking platform and flake-release surface form an acute plano-convex profile. One or more of the burin flake scars are terminated by an notch or retouch.
Carinated burin	A multiple burin whose striking platform and flake-release surface form a plano-convex profile.
Flat-faced carinated burin	Carinated burin with a relatively flat flake-release surface.
Right angle straight truncation burin	A burin on which the burin flake is parallel to the central/long axis of the piece and the truncation is perpendicular to it.
Oblique straight truncation burin	Straight truncation burin whose burin scar is aligned obliquely to the truncated edge.
Burin on a concave truncation	A burin on which the burin flake is parallel to the central/long axis of the piece and the truncation is concave.
Burin on a convex truncation	A burin on which the burin flake is parallel to the central/long axis of the piece and the truncation is convex.
Burin on a lateral preparation	Burin struck from a prepared surface on a lateral edge and aligned parallel to the long axis of the tool.
Oblique burin on a lateral preparation	Burin on a lateral preparation whose burin scar is aligned obliquely to the tool's long axis.

Type Name	Definition
Transverse burin on a lateral preparation	Burin struck from a prepared lateral edge and aligned perpendicular to the tool's long axis.
Transverse burin on a notch	Transverse burin on a lateral preparation whose retouched lateral edge is concave.
Multiple burin on a truncation	Multiple burin scars struck from a single truncated edge.
Mixed multiple burin	A burin featuring more than one of the dihedral burin types and the types of burins on retouched truncations.
Burin on a Levallois point	Triangular flake on which a burin has been detached from the distal end.

burination (the detachment of a burin spall) was a way of removing use-damaged edges. Burination could also have been a technique for reshaping the lateral edges of an elongated artifact for hafting without the risk of lateral breakage entailed in conventional retouch/backing (Barton, Olszewski, and Coinman 1996) (see CUP Website Figure 28).

Burin detachment flakes (burin "spalls") could have been used as tools. Epipaleolithic and ethnographic humans demonstrably used burin spalls and similar small artifacts for fine piercing and cutting tasks. If this was the case, it is possible that some burins may actually have been cores or combinations of cores and tools used in their own right.

Typologically-Significant Retouched Tools

Several kinds of Upper Paleolithic retouched tools have diagnostic value for linking assemblages to one another. These include several kinds of retouched blades/bladelets, chamfered pieces, and several named types of points, and carinated pieces.

Retouched Blades/Bladelets

Blades and bladelets exhibit a continuum of retouch ranging from what appear to be minor efforts to adjust edge shape to extensive and invasive retouch (see Figure 5.8). Among retouched blades and bladelets, there

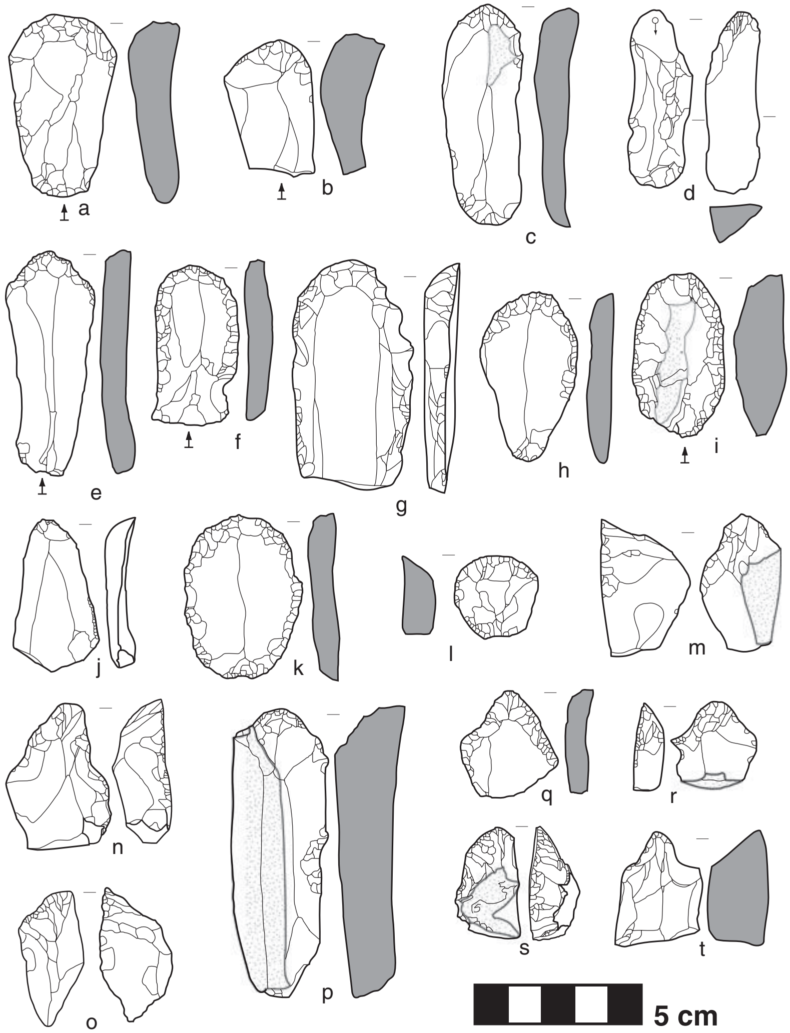


FIGURE 5.6. Upper Paleolithic endscrapers. a. single endscraper, b. atypical endscraper, c. double flat endscraper, d. alternate flat endscraper, e. ogival endscraper, f. endscraper on retouched blade, g. endscraper on Aurignacian blade, h. fan-shaped endscraper, i. flake scraper, j. endscraper on a levallois point, k. circular (end)scraper, l. thumbnail endscraper, m. carinated endscraper, n. atypical carinated endscraper, o. lateral carinated endscraper, p. thick-nosed endscraper, q. flat-nosed or shouldered endscraper, r. micro-carinated endscraper, s. multiple carinated endscraper, t. atypical carinated endscraper. *Sources:* Ksar Akil (a–k, m, n–t), Abu Halka IV (l), Hayonim Level D (n). Redrawn after Azoury (1986), Belfer-Cohen & Bar-Yosef (1981), Bergman (1987), Ohnuma (1989).

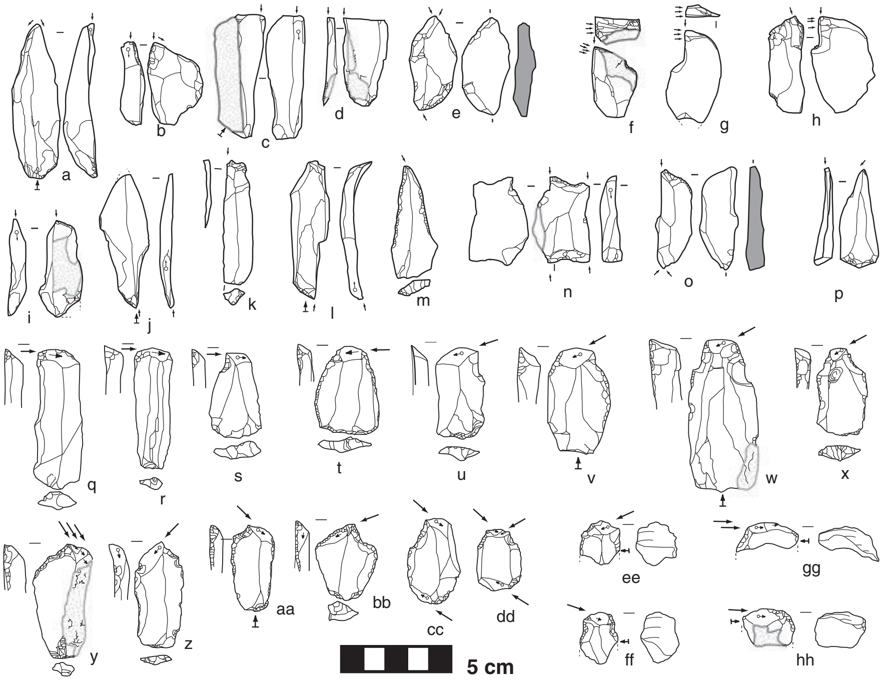


FIGURE 5.7. Upper Paleolithic burins (a–p) and chamfered pieces (q–hh). a. straight dihedral burin, b. offset dihedral burin, c. angle dihedral burin, d. angle dihedral burin on break, e. multiple dihedral burin, f. beaked burin, g. carinated burin, h. flat-faced carinated burin, i. right angle straight truncation burin, j. oblique straight truncation burin, k. burin on a concave truncation, l. burin on a convex truncation, m. oblique burin on a lateral preparation, n. multiple burin on a truncation, o. mixed multiple burin, p. burin on a Levallois point, q–t. chamfered pieces on lateral preparation, u–v. chamfered pieces on a notch, w–x nosed chamfered piece subtype, y–bb. oblique chamfered pieces on truncation, cc–dd. multiple chamfered pieces, ee–hh. tips of endscrapers detached by chamfer fracture. *Sources:* Boker Area A (a, l), Central Negev Site D26 (b, f), Central Negev Site D18 (c), Boker Tachtit Levels 1–3 (d, i–j), Ksar Akil Levels XVII–XXIII (e, k, m–o), Ein Aqev/D31 (g), Central Negev Site K9A (h), Ksar Akil Level XXII (p), Ksar Akil Levels XXV–XVII (q–hh). Redrawn after Azoury (1986), Jones et al. (1983), Marks and Larson (1977), Marks (1983; 1976a), Marks and Ferring (1976), Newcomer (1970), and Ohnuma (1989).

are three artifact-types that have long been thought to link Levantine assemblages to European Aurignacian assemblages. Dufour bladelets are bladelets with minimally invasive marginal retouch that can be dorsal, ventral, or alternating. When this retouch is steep, it is said to

Table 5.4. *Definitions of Upper Paleolithic Chamfered Pieces (*chanfreins*)*

Type Name	Definition
Chamfered piece on lateral preparation	Piece on which the chamfering flake is detached from a retouched lateral edge.
Chamfered piece on a notch	Piece on which the chamfering flake is detached from one side of a notched edge.
Oblique chamfered piece on truncation	Tool on which the chamfering flake originates on a truncated edge and propagates obliquely to the tool's long axis.
Multiple chamfered piece	Tool with more than one chamfered edge.

be "Ouchtata" retouch (after a site in Morocco). Aurignacian blades are relatively large, thick blades with continuous retouch along both lateral edges. They differ from other retouched blades in that the retouch is both scalar and relatively invasive.

"Microliths" or "geometric microliths" are blades/bladelets that have been extensively modified by backing and/or truncation. Microliths occur in small numbers among many Levantine Upper Paleolithic assemblages, however, they exhibit little patterned variation, except in the youngest of Upper Paleolithic assemblages. (Microliths are more significant for Epipaleolithic industrial variability and are discussed Chapter 6.)

Chamfered Pieces

Chamfered pieces (or *chanfreins*) are flakes, blades, or fragments that have been resharpened by a burin fracture (chamfering flake) that propagates perpendicular to the tool's long axis and obliquely to its dorsal-ventral plane (Newcomer 1970). The resulting edge has a flat, broad, chisel-like configuration. These tools are, in effect, a kind of transverse burin. The scar from this fracture is usually located at the distal end of the tool, although double and multiple chanfreins sometimes involve the proximal end of the tool as well. Chanfreins are an intermediate form between endscrapers and burins, and these artifact-types grade into one another. Chamfered pieces occur mainly among early Upper Paleolithic contexts, and four main kinds of chamfered pieces are recognized (Table 5.4 and Figure 5.7.q–hh).

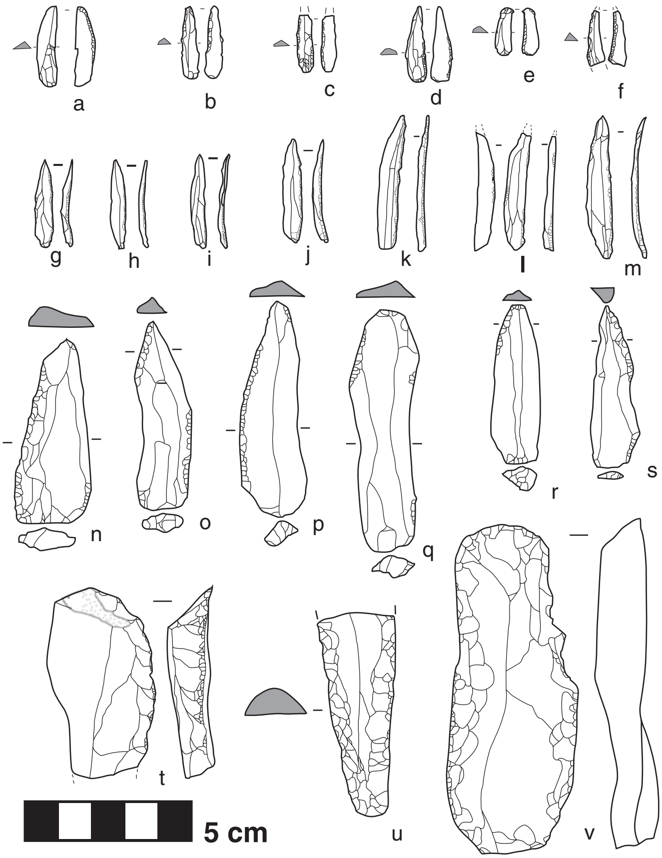


FIGURE 5.8. Upper Paleolithic retouched blades: a–f. Dufour bladelets, g–m. Ouchtata backed bladelets, n–s. partially-backed bladelets, t–v. heavily-retouched "Aurignacian" blades. *Sources:* Ksar Akil Level VI (a–f), Ain El-Buheira (g–m), Ksar Akil Level XX (n–s), Ein Aqev/D31 (t), Hayonim Cave Level D (u–v). Redrawn after Azoury (1986), Belfer-Cohen & Bar-Yosef (1981), Bergman (1987), Coinman (2000b), Marks (1976a).

Points

Mousterian and Levallois points occur in Upper Paleolithic assemblages, but they become less and less common through time. Levantine Upper Paleolithic assemblages feature five novel forms of pointed artifacts: Emireh points, Umm el Tlel points, and various kinds of El Wad points (see Figure 5.9).

Emireh points (Figure 5.9.a–d) are triangular flakes or pointed blades that have had their bulbar eminence removed by retouch

(Garrod 1955). Projections at the proximal end on the dorsal surface are often removed as well. There is sometimes retouch at the distal tip. Emireh points are found throughout the Levant and are considered lithic "index fossils" of the early Upper Paleolithic Emiran industry (Volkman and Kaufman 1983).

Umm el Tlel points (Figure 5.9.e–j) are Levallois points that have had the proximal ends of dorsal scar ridges removed prior to flake detachment by bladelet-like removals (Boëda and Bonilauri 2006, Bourguignon 1998). Like Emireh points, Umm El Tlel points seem to occur mainly in early Upper Paleolithic assemblages. They are thus far known only from Umm el Tlel, but these newly recognized tools are so subtly different from Levallois points that it is possible many of them have eluded detection in older collections.

Unifacial points (*pointes à face plan*) (Figure 5.9.k–m) are unifacially retouched points made from blades or elongated flakes. Invasive retouch extends from the distal tip along lateral edges beyond the midpoint of their length. Unifacial points have been formally recognized at Ksar Akil (Bergman 1981), but they occur in other Levantine Upper Paleolithic assemblages as well.

El Wad points (Figure 5.9.q–gg) are pointed blades or bladelets whose tips are shaped by fine and/or steep retouch, usually on their dorsal face (Bar-Yosef 1970, Brézillon 1977, Marks 1976b). The amount of retouch along one or both lateral edges varies widely, as does the location of this retouch on dorsal or ventral faces. In older references, El Wad points are sometimes described as "Font Yves points," a term imported from European Upper Paleolithic typology.

In his analysis of Upper Paleolithic points from Ksar Akil Rockshelter, Bergman (1981: 322) initially distinguished "Ksar Akil points" (which have straight profiles) from El Wad points (which are curved). Ksar Akil points occur in earlier contexts, El Wad points in later ones. The distinction has not been widely adopted in other studies. Some researchers distinguish El Wad points with marked curvature in either distal-proximal or mediolateral dimensions as "Twisted El Wad points" and "El Wad Variant points" (respectively).

The dividing line between El Wad points and obliquely backed and/or truncated blades is not a clear one. The main difference (judging from illustrated examples) is that backing/retouched on El Wad points is steep or semi-abrupt and noninvasive, while the retouch on backed/truncated blades is more invasive.

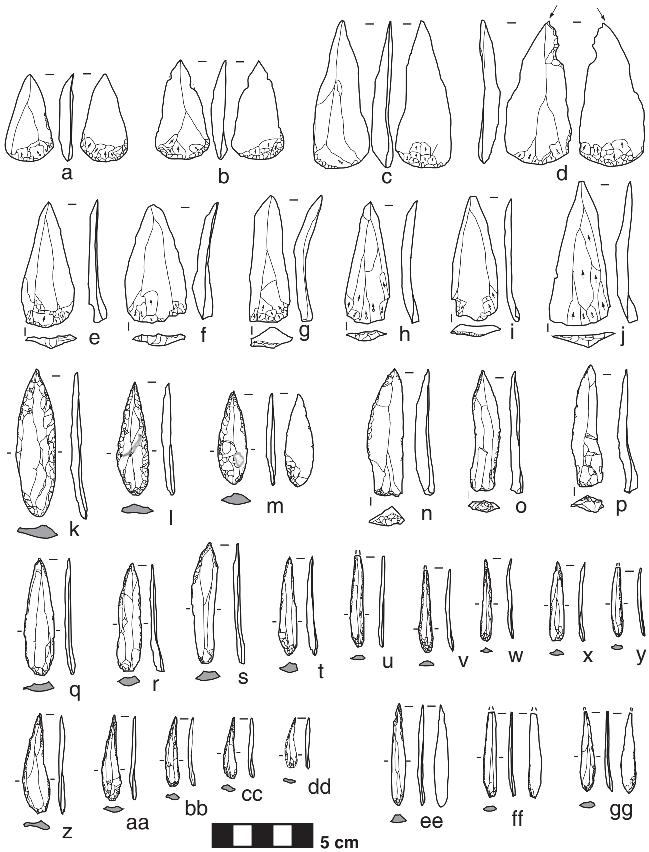


FIGURE 5.9. Upper Paleolithic points. a–d. Emireh points, e–j. Umm El Tlel points, k–m. unifacial points, n–y. El Wad points, z–cc. twisted El Wad points, ee–gg. El Wad point variants. *Sources:* Boker Tachtit, Levels 1–4 (a–d), Umm El Tlel Levels III2a (e–i) and IIa base (j). Ksar Akil Levels XXV–VI (l–gg). Redrawn after Bergman (1988), Bourguignon (1998), Marks (1983).

(Because of their asymmetrical cross section, "Falita points" are treated as a kind of backed blade.)

Many Upper Paleolithic stone points are thought to have been the tips of projectile weapons, either hand-cast spears, spearthrower darts, or arrows (Larsen-Peterkin 1993). El Wad points and bone points from Ahmarian and Levantine Aurignacian contexts are comparable to ethnohistoric stone projectile points in their key ballistic dimensions (Shea 2006b). Emireh points and El Wad/Ksar Akil points feature distal impact fractures similar in size and overall appearance to damage on replicated points used in archery experiments (Bergman and Newcomer 1983, Marks and Kaufman 1983). Similar damage on bone/antler points from Upper Paleolithic contexts is a further indication of Upper Paleolithic projectile technology (Newcomer 1984).

Common Retouched Tools

Most Levantine Upper Paleolithic assemblages contain "common" (i.e., widely shared) artifacts such as scaled pieces, perforators, backed pieces, limaces, truncations, notches, denticulates, and others that do not play a major role in industrial systematics (Table 5.5 and CUP Website Figures 29–30).

Perforators, backed knives, truncations, notches, denticulates, and many of the retouched pieces that occur in Levantine Upper Paleolithic assemblages differ little from their Middle Paleolithic counterparts other than being more often made on prismatic blades and byproducts of prismatic blade production (Figure 5.10). Of these, only scaled pieces, combination tools, backed pieces, unifacial points/limaces, and Ksar Akil scrapers merit discussion.

Scaled pieces are flake fragments with large-scale fracturing and crushing on at least one edge. Most often, this fracturing and crushing occurs in pairs on opposite sides of the tool (i.e., right and left lateral, distal and proximal ends). Like their counterparts from Lower and Middle Paleolithic contexts, it remains unknown whether the flake scars on scaled pieces result from deliberate bipolar percussion or if they are instead byproducts of some mode of tool use that results in large-scale edge damage. Experimental use of stone flakes as wedges in woodworking produces damage nearly identical to that on many Upper Paleolithic scaled pieces (Shea 1991). If one accepts either of these models for the formation of scaled pieces, then scaled pieces should not be viewed as retouched tools, but instead as pieces damaged from tool production and/or use.

Combination tools differ from other retouched tools mainly in featuring at least two distinct morphologically different retouched edges. In essence, they combine, pairwise, the features of scrapers, burins, perforators, or truncations. The pairing of burins and endscrapers is particularly common. Some of these combination tools may simply reflect the recycling of artifacts made for use in one task into some

Table 5.5. *Definitions of Common Upper Paleolithic Retouched Tools (perforators, backed knives, truncations, notches and denticulates, combination tools, and miscellaneous retouched pieces)*

Type Names	Definition
Perforators	
Typical perforator (Perforator, Curved perforator)	Flake or blade whose distal end features a straight, canted, or curved point. The point is clearly defined by bilateral retouch, sometimes alternating, with a single or double shoulder.
Atypical perforator (Spike, Bec)	Flake or blade with a thick or broad projection formed adjacent to retouched concavities rather than to retouch on the tip of the perforator itself.
Heavy perforator	Relatively large perforator.
Micro-perforator	Perforator made on a bladelet or small flake.
Multiple perforator	Flake, blade, or bladelet with several perforators, becs, or micro-perforators, sometimes associated with notches.
Backed Knives	
Naturally-backed knife	Blade or elongated flake with one lateral edge blunted by cortex or by a steeply convergent edge (not by retouch). The overall shape of the tool is symmetrical.
Atypical backed knife	Blade or elongated flake with one lateral edge and whose overall shape of the tool is asymmetrical.
Knife with a curved back	Backed knife whose backed edge is convex in plan view.
Knife with a straight back	Backed knife whose backed edge is straight in plan view.
Piece with an irregular back	Backed knife whose backed edge is irregular in plan view.
Piece with two backed edges	Blade or elongated flake with backing on both lateral edges.
Partially backed piece	Blade or elongated flake with backing on part of one lateral edge.
Backed point (aka Falita point)	Blade backed along one edge and on the ventral face of its pointed distal end and base.
Backed fragment	Fragment of a flake or blade backed along one edge.
Shouldered piece	Blade or elongated flake on which one corner of the

(*continued*)

Table 5.5 (*continued*)

Type Names	Definition
	piece has been removed by retouch along a lateral edge.
Truncations	
Truncated flake	Flake with a truncated end (usually the distal end).
Truncated blade	Blade with a truncated end (usually the distal end).
Piece with curved truncation	Piece with a truncated edge that is convex in plan view.
Bi-truncated piece	Piece truncated at distal and proximal ends.
Backed and truncated piece	Piece with truncation at distal and/or proximal ends and at least one lateral edge.
Notches and Denticulates	
Clactonian notch	Piece with a notch formed by a single large retouch scar.
Retouched notch	Piece with a notch formed by multiple retouch scars.
Blade or bladelet with multiple notches	Blade or bladelet with more than one discrete notch along its edge.
Denticulate	Pieces with a semi-continuous series of small concavities along an edge.
Alternate burinated bec	Bec or perforator formed by a pair of notches on opposite (dorsal/ventral) sides of the piece.
Combination Tools	
Endscraper/sidescraper	A piece with scraper retouch on distal and lateral edges.
Endscraper/burin	(Flat) endscraper with a burin on the opposite end of the tool.
Carinated endscraper-burin	Carinated endscraper with a burin on the opposite end of the tool.
Endscraper/truncated piece	Piece with scraper retouch at one end, truncation at the opposite end.
Burin-truncated piece	Flake/blade fragment with burin at one end and truncation at the opposite end.
Perforator-truncated piece	A flake/blade fragment with a perforator at one end and a truncation on the opposite end.
Perforator-endscraper	A flake/blade fragment combining perforator and endscraper retouch at opposite ends.
Perforator-burin	A flake or blade fragment combining perforator retouch at one end and burin removals at the other.
Other combinations	Any other combination.

Type Names	Definition
Miscellaneous Retouched Pieces	
Flake with continuous retouch	Flake with continuous retouch on distal and lateral edges.
Blade with continuous retouch on one edge	Blade with continuous retouch along only one lateral edge.
Blade with continuous retouch on both edges	Blade with continuous retouch along both lateral edges.
Pointed piece	Piece with retouched lateral edges that converge at their distal end.
Piece with inverse or alternate retouch (includes Dufour bladelet)	Flake, blade, or fragment with retouch on its ventral face or both ventral and dorsal faces.
Raclette	Small flake with small semi-abrupt retouch around its circumference.
Denticulated scraper (Ksar Akil scraper)	Scraper with a denticulated edge.
Miscellaneous and Pebble tools ("Divers")	Core-tools shaped from pebbles or cobbles.

novel activity. In other cases, retouch or burination may reflect modification for hafting or prehension.

Backed pieces, as noted previously, are blades with one steeply retouched edge. In any large number of Upper Paleolithic tools the extent of this backing grades from partially backed pieces, to pieces with "full" backing along one edge, to ones with multiple backed/retouched edges. Often these backed edges converge at one or both ends of the blade. Such pointed backed pieces grade from unifacial points to limaces. The difference between unifacial points and limaces is a subjective assessment of whether the piece is thin or thick in cross section, respectively. Whether backed pieces, unifacial points, and limaces comprise stages in a tool reduction sequence remains unknown, but such hypothesis would be in line with the role curation by retouch seems to play in the variability of other Paleolithic artifacts (Dibble 1995).

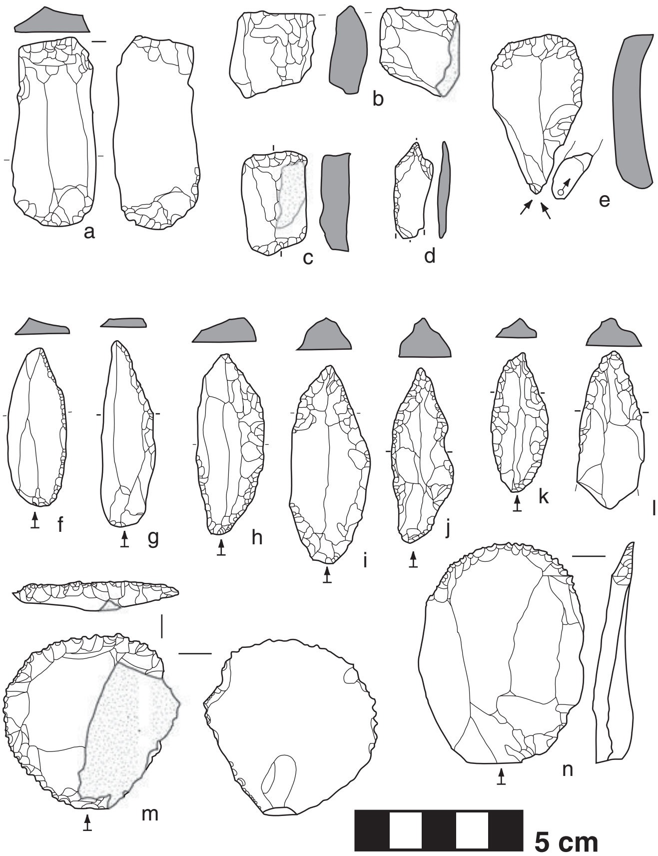


FIGURE 5.10. Miscellaneous Upper Paleolithic retouched tools. a–b. scaled pieces, c. double truncation, d. perforator, e. combination tool (endscraper and dihedral burin), f–g. backed pieces, h–l. limaces/unifacial points, m–n. Ksar Akil scrapers. *Sources:* Ksar Akil Levels XI–XXI (a–l), Thalab al-Bheira (m), Boker BE Level IV (n). Redrawn after Azoury (1986), Coinman (2002), Marks (1983).

Ksar Akil scrapers are flakes or blades whose principal retouched edge features a series of minute denticulations (Coinman 2002, Copeland 1982). Most Ksar Akil scrapers are either endscrapers or transverse scrapers. Sidescrapers, double scrapers, or convergent scrapers with such denticulate retouch are classified as denticulates.

Grinding and Pounding Tools

Most reported Upper Paleolithic hammerstones (Figure 5.11.a–c) are less than 15 cm long, elongated, and thin in cross section. Many

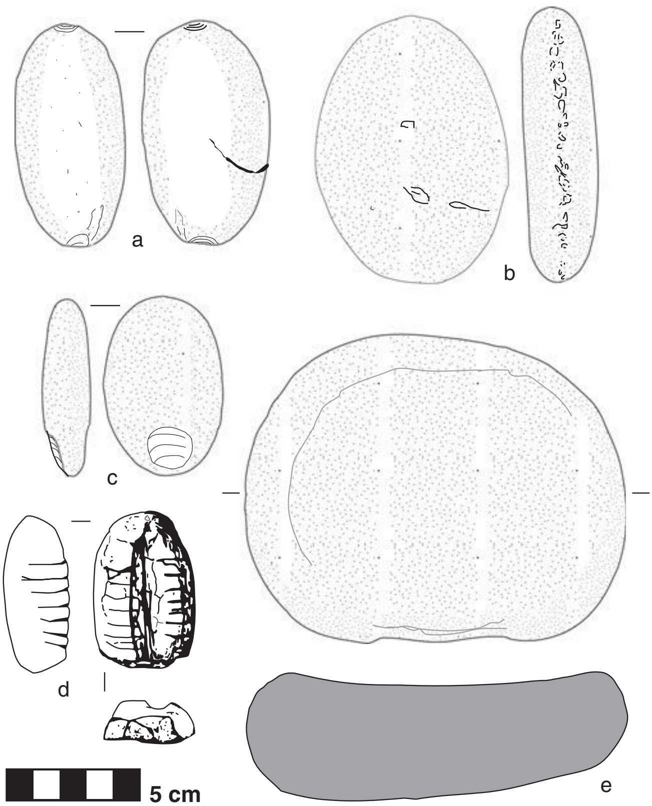


FIGURE 5.11. Upper Paleolithic hammerstones and groundstone tools. a. hammerstone (flint), b. hammerstone (andesite?), c. hammerstone (basalt), d. grooved stone (basalt), e. grinding stone (basalt). *Sources:* Ksar Akil Levels XXI–XVII (a–c), Hayonim Level D (d), Ein Aqev (e). Redrawn after Belfer-Cohen & Bar-Yosef (1981), Marks (1976a), Ohnuma (1989).

specimens feature pitting and comminution at one or both ends of their long axis. Others feature pitting that makes a continuous circuit around the periphery of the tool. Such intense and focused damage patterns contrast with the less concentrated damage on Lower and Middle Paleolithic hammerstones (except for spheroids and subspheroids). This kind of patterned damage suggests a stereotyped, repetitive mode of flintknapping. Similar kinds of concentrated pitting and comminution are common features on hammerstones discarded by modern-day flintknappers.

Upper Paleolithic assemblages contain a small number of tools used for abrasion and/or pounding (Figure 5.11.d–e). Most of these artifacts are either anvils/grinding slabs or "hammerstones/ handstones" (Wright 1994). Anvils/slabs such as those found at Upper Paleolithic sites are similar to artifacts used by ethnographic hunter-gatherers for pulverizing seeds and for grinding mineral pigments. Grooved stones from Hayonim D are similar to ethnographic "shaft straighteners," tools thought to have been used to smooth the wooden shafts of arrows and spearthrower darts.

(Groundstone tools are more common in Epipaleolithic and Neolithic contexts than in Upper Paleolithic ones. Most classifications of Upper Paleolithic groundstone tools are much less complex and contingent than those used to describe Epipaleolithic and Neolithic artifacts [see Chapters 6 and 7.])

IV. UPPER PALEOLITHIC INDUSTRIES

Prior to the 1990s, most frameworks for Levantine Upper Paleolithic systematics were organized in a stage-wise progression modeled after the cultural stratigraphy of Ksar Akil Levels 6–25 (Copeland 1975, Garrod 1957, Neuville 1934). The assemblage groups comprising this sequence have undergone many changes of names and groupings (see Table 5.6). The framework used here uses the most popular grouping in recent published overviews of the period (Belfer-Cohen and Goring-Morris 2003).

The Levantine Upper Paleolithic is usually divided ca. 27,000 bp (29 Ka cal. BP) into Early and Later phases (see Table 5.7).

Early Upper Paleolithic Assemblage Groups

Earlier Upper Paleolithic assemblage-groups include the Emiran, Early Ahmarian, and Levantine Aurignacian assemblage-groups (see Figure 5.12).

Emiran

Emiran assemblages are best documented at Boker Tachtit, Umm El Tlel, Ksar Akil Rockshelter, and Üçağızlı Cave, where they date to 38,000–>45,000 bp (41–49 Ka cal. BP). Emiran assemblages feature both Levallois and unidirectional prismatic blade core technology, with the latter predominating among more recent assemblages.

Table 5.6. *Chronostratigraphic Frameworks for the Levantine Upper Paleolithic on the Basis of the Stratigraphy of Ksar Akil*

Ksar Akil Levels	Characteristic Artifact-Types	Neuville (1934)/ Garrod (1957)	Gilead (1991)	Bar-Yosef & Belfer-Cohen (2010)
I–IV	numerous truncated and pointed bladelets	VI. Kebaran	Kebaran	Kebaran
VI	blade/bladelets with fine retouch			Late Ahmarian (Masraqan)
VII	polyhedral and truncated burin	V. Atlitian	Levantine Aurignacian C	Atlitian
VIII–X	Aurignacian endscrapers, few El Wad points	IV. Upper Antelian	Levantine Aurignacian B	Levantine Aurignacian
XI–XIII	Aurignacian endscrapers, many El Wad points	III. Lower Antelian	Levantine Aurignacian A	Levantine Aurignacian
XVI	Pointed blades, endscrapers, burins	II. Unnamed	Ksar Akil Phase B	Early Ahmarian
XXI–XXV	Emireh points, Levallois blades	I. Emiran	Ksar Akil Phase A	Emiran

Emireh points and chamfered pieces are the most distinctive Emiran artifact-types. In earlier Emiran assemblages Emireh points are made on triangular flakes (probably Levallois points), while in later assemblages they are made on pointed blades. Chamfered pieces are made on blades and elongated flakes and they are somewhat more common in the northern Levant than in assemblages from the south. Umm el Tlel points occur in Emiran contexts at Umm El Tlel, but it is not yet clear if they have a more widespread distribution. Some chamfered pieces are known from Emiran assemblages.

The naming of the earliest Upper Paleolithic assemblages is a complex issue. Garrod (1951, 1955) introduced the term "Emiran" on the basis of her excavations at Emireh Cave, replacing Neuville's "Upper Paleolithic Phase 1." The revelation that many Emiran assemblages in coastal caves were derived from sediments that had been mixed by karst spring activity (Bar-Yosef and Vandermeersch 1972), led many

Table 5.7. *Levantine Upper Paleolithic Assemblage-Groups and Selected Representative Assemblages*

Period	Assemblage Group	Representative Assemblages
Earlier Upper Paleolithic >45,000–27,000 bp 49–28 Ka cal. BP	Emiran	Boker Tachtit Levels 1–4
		Emireh Cave
		Ksar Akil Rockshelter Levels XXI–XXV
		Tor Sadaf A-B/Units III (lower)-IV
		Üçağızlı Cave F–I
		Umm el Tlel II base, III 1 a
	Early Ahmarian	Abu Noshra Sites I, II, IV, VI
		Boker A
		Boker BE-III
		Ein Qadis IV
		Erq el-Ahmar Rockshelter E/F
		Kebara Cave E/Units III–IV
		Ksar Akil Rockshelter Level XX
		Lagama Sites V–VIII, X–XII, XV–XVI
		Qadesh Barnea Sites 601A, 601B, 501, 9A,B,C
		Qafzeh Cave E/D/Levels 8–9
		Qseimeh I, III
		Raqefet Cave V–VIII
		Site A306a
		Thalab al-Buhira E, C
		Tor Hamar
		Tor Sadaf Rockshelter I–III
		Üçagizli Cave B–C
		Umm el Tlel (I 4' c', F1, 1p, II 1 b-II 2 a, II 2 d, II 1 b-II 2 a, II 4 α, II 4 γ)
		Yabrud Rockshelter II Levels 5–6
	Levantine Aurignacian	Central Negev Sites D14, D18, D22, D27A,B
		El-Quseir
		Hayonim Cave D
		Kebara Cave D/Units I–II
		Ksar Akil Rockshelter VII
		Raqefet Cave Levels III–IV

Period	Assemblage Group	Representative Assemblages
		Umm el Tlel (I 2'a'-I4'b', F5-F6, W1a–W2d, II 2 b-II 3 d)
		Yabrud Rockshelter II (Levels 1–4)
Later Upper Paleolithic 27,000–19/20,000 bp 28–23/22Ka cal. BP	Atlitian	El Khiam Rockshelter E (9–10)
		El Wad Cave C
		Fazael Site IX
		Ksar Akil Rockshelter VII
		Nahal Ein Gev I
	Arqov/Divshon Group	Arqov/Avdat (Ain Aqev/Boker C)
		Boker BE Level I
		Ein Aqev (D31) Levels 5–12
		El Kowm
		Har Horesha 1
		Madamagh
		Qadesh Barnea 602
		Qseimeh II
		Shunera XV
	Late Ahmarian and/or Masraqan	Ain el-Buhira (WHS 618)
		Azariq XIII
		Azraq 17 Trench 2
		Ein Aqev East (D34)
		Fazael Site X
		Ksar Akil Rockshelter III–VI
		Lagama X
		Masraq e-Na'aj
		Meged Rockshelter
		Nahal Sekher 122
		Ohalo II
		Qafzeh Cave Layers 6–11
		Shunera XVI
		Umm El Tlel
		Wadi Sudr 6
		Yutil el-Hasa (WHS 784)
Montane Upper Paleolithic 35–21 bp 38–23 Ka cal. BP	Baradostian (aka Zagros Aurignacian)	Karaïn Cave B Level 19–23
		Shanidar Cave Level C
		Warwasi Cave Levels P–LL
		Yafteh Cave Levels 4–22

prehistorians to abandon the term. During the 1980s, Levantine prehistorians began referring to these assemblages as "Ksar Akil Phase A," "Middle-Upper Paleolithic Transitional," or, for brevity, "Transitional" or "Initial Upper Paleolithic" (Bar-Yosef 1989, Copeland 1975, Kuhn 2003, Marks 1983b). The difficulty with using these terms is that they implicitly accept hypotheses about these assemblages' relationships with other assemblage groups. The term Emiran is retained here because it carries no such implications, and it is formally homologous with the names of other Paleolithic and Neolithic industries.

Early Ahmarian

Early Ahmarian assemblages date to between 38/37,000 and 28/27,000 bp (45–30 Ka cal. BP). The term "Ahmarian" is derived from the site of Erq el-Ahmar, a rockshelter in the Judean Desert excavated by Neuville (1951). The most distinctive Early Ahmarian artifact-types are El-Wad points and Ksar Akil points. Blade cores are often narrow-fronted and characteristically high-arched and distally tapering flake-release surfaces. Platform preparation includes facetting, but this practice declines over time, being replaced by platform abrasion. The prismatic blade component of Early Ahmarian assemblages contains many pointed blades/bladelets. The blades and bladelets struck from Early Ahmarian blade cores are generally straight in plan view and show relatively little ventral curvature. Much of the retouch on blades and bladelets seem to have been to reduce irregularities along their edges rather than resharpening. Endscrapers and burins are present but rare among retouched tool inventories. When they do occur, they are often made on cortical flakes or on flakes detached in the course of core-rejuvenation. Chamfered pieces occur among Early Ahmarian assemblages in the northern Levant, but are less common in the South.

Early Ahmarian assemblages retain little Levallois technology, and in this sense at least, are generally regarded as the earliest "fully" Upper Paleolithic entity. Early Ahmarian assemblages have a pan-Levantine distribution, but they are somewhat better-documented at open-air sites in the interior of Syria, Jordan, and southern Israel. The Lagaman industry of the Sinai (Bar-Yosef and Phillips 1977) exhibits many of the same technological and typological characteristics as early Ahmarian ones, and it seems reasonable to treat it as a local variant of the Early Ahmarian.

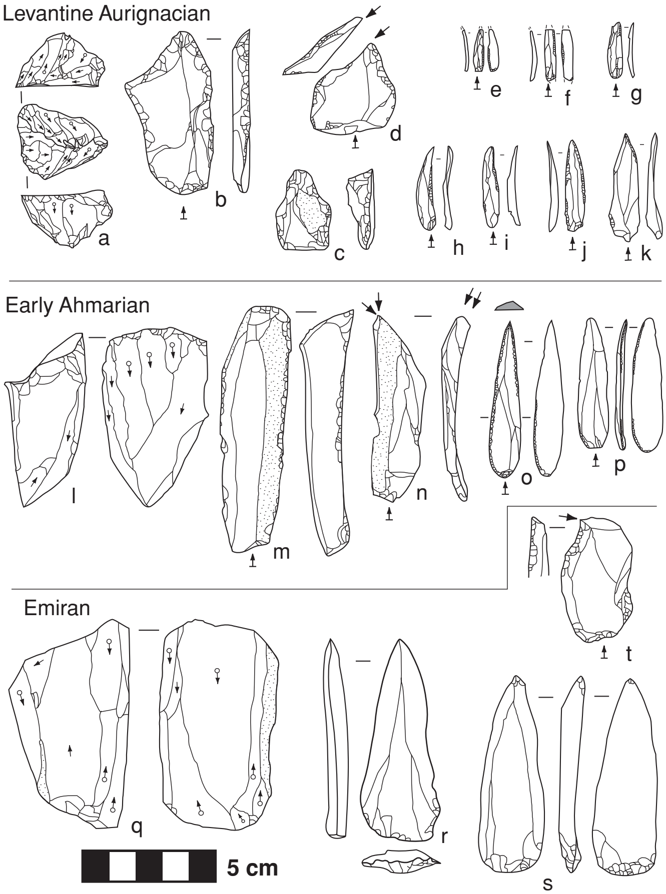


FIGURE 5.12. Earlier Upper Paleolithic artifacts. Levantine Aurignacian (a–k), Early Ahmarian (l–p), Emiran (q–t). a. carinated piece/bladelet core, b. shouldered scraper with invasive lateral retouch, c. carinated scraper, d. burin on oblique truncation, e–g. Dufour bladelets, h–k. twisted and/or curved El Wad points, l. narrow-fronted blade core with unidirectional-convergent preparation, m. endscraper on blade, n. burin on blade, o–p. straight El Wad points, q. Levallois point core with bidirectional-opposed preparation, r. Umm el Tlel point, s. Emireh point, t. chanfrein endscraper. *Sources:* Ksar Akil Level X (a), Hayonim Cave Level D (b–k), Ain al-Buheira Area C (l), Ain Qadis (m–n), Tor Sadaf (o–p), Boker Tachtit (q, s), Umm El Tlel (r), Ksar Akil Level 22 (t). Redrawn after Belfer-Cohen & Bar-Yosef (1981), Bergman (1987), Bourguignon (1998), Coinman (2003), Marks (1983a), and Newcomer (1988).

The Ahmarian has been recognized as a discrete entity only since the early 1980s. In older references it is sometimes described as Phase II Upper Paleolithic (in the Neuville/Garrod framework) or "Ksar Akil Phase B" (Gilead 1988).

Levantine Aurignacian

Levantine Aurignacian assemblages date to 32,000–26,000 bp (35–29 Ka cal. BP) and they are known mainly from cave sites near the Mediterranean Coast. The name "Aurignacian" derives from the town of Aurignac, France, and its application to Levantine assemblages reflects perceived similarities with European early Upper Paleolithic Aurignacian assemblages (Belfer-Cohen and Bar-Yosef 1999, Belfer-Cohen and Goring-Morris 2003). These similarities include nosed and shouldered carinated cores/scrapers made on flakes, Dufour bladelets (often retouched on the ventral face), and large flakes and blades with invasive "scalar" retouch. El Wad points occur in Levantine Aurignacian assemblages, but they are smaller than their Ahmarian counterparts. Large core reduction emphasizes the production of flakes rather than blades. Other non-lithic parallels with European Aurignacian assemblages include a carved bone/antler industry, one featuring perforated shells, teeth, and bone points (including split-based forms).

In older references (Garrod 1957, Neuville 1934), the earlier phases of the Levantine Aurignacian are called Lower and Upper Antelian (after Wadi Antelias, Lebanon). Recent references often distinguish between "Classic Levantine Aurignacian" assemblages and those from Later Upper Paleolithic contexts that do not preserve the same suite of characteristics as Early Upper Paleolithic examples (Belfer-Cohen and Goring-Morris 2003).

Later Upper Paleolithic Assemblage-Groups

The Later Upper Paleolithic includes the Atlitian, the Arqov/Divshon Group, and Late Ahmarian/Masraqan assemblage-groups (see Figure 5.13).

Atlitian

Atlitian assemblages date to 27,000/26,000 bp (29–30 Ka cal. BP) and they are known mainly from sites on the Mediterranean Coast and

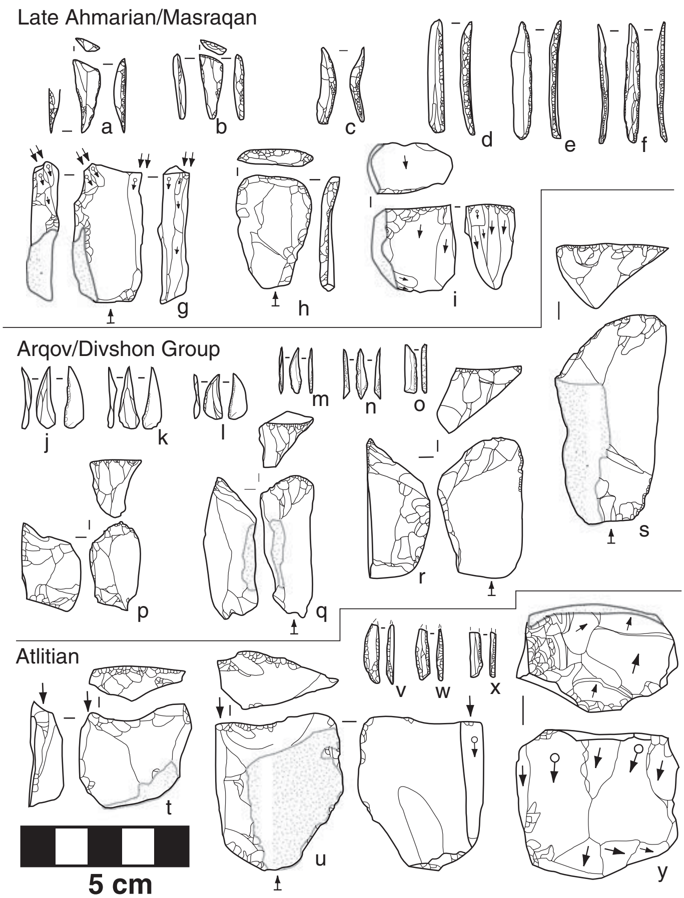


FIGURE 5.13. Later Upper Paleolithic artifacts. Late Ahmarian/Masraqan (a–i), Arqov/Divshon Group (j–s), Atlitian (t–y). a–b. proto-triangles, c. micropoint, d–f. pointed backed bladelets, g. multiple burin, h. endscraper, i. bladelet core, j–l. Dufour bladelets, m. bilaterally-retouched bladelet, n. microgravette, o. backed and truncated bladelet, p. carinated piece, q–r. obliquely carinated pieces, s. obliquely-carinated endscraper, t–u. burin on concave truncation/notch, v–x. retouched backed bladelets, y. flake core. *Sources:* Ohalo II (a–i), Ein Aqev/D31 (j–s), Nahal Ein Gev I (t–y). Redrawn after Belfer-Cohen et al. (2004), Marks (1976a), Nadel (2002).

in the Jordan Rift Valley. The name "Atlitian" is derived from Atlit, a village near Mount Carmel. These assemblages feature numerous truncation burins, mostly on flakes. Points are rare. There is little evidence for systematic blade/bladelet production. Gilead (1991) refers to Atlitian assemblages as "Levantine Aurignacian C," reflecting his view that Atlitian assemblages are derived from this technological tradition. Goring-Morris and colleagues (2009: 198) argue Atlitian assemblages are unrelated to Levantine Aurignacian precursors.

Arqov/Divshon Group

The Arqov/Divshon Group unites a series of flake-based assemblages from open-air sites in the Negev and Sinai (Marks and Ferring 1976). Assemblages belonging to the Arqov/Divshon Group feature few points, but many laterally carinated pieces. These laterally carinated pieces differ from the more common variety in that the thickest part of their carinated edge is significantly offset from the midpoint of the edge when viewed edge-on. Most Arqov/Divshon assemblages date to between 22,000 and 28,000 bp (19–31 Ka cal. BP).

Late Ahmarian/Masraqan

Blade-based Upper Paleolithic assemblages dating to less than 27/28 Ka cal. BP are described as either "Late Ahmarian" or "Masraqan" (after Masraq e-Na'aj in Jordan). Such assemblages are known mainly (though not exclusively) from sites in the steppic interior parts of the Levant dating to 20,000–28/27,000 bp (30–32/22 Ka cal. BP). Technologically, Late Ahmarian/Masraqan assemblages feature laminar core reduction emphasizing the production of bladelets over blades from narrow-fronted cores. Masraqan blade cores are narrow, most often with single platforms. Striking platform surfaces are often heavily abraded, creating the appearance of carination. Most of the bladelets struck from these cores are slightly curved, but not twisted. The larger flakes/blades that occur in Masraqan assemblages appear to be products of a different core technology. Retouched artifacts include numerous narrow and finely retouched bladelets with steep and minimally invasive (Ouchtata) retouch along their lateral edges. The pointed distal ends and striking platforms of these bladelets often remain unmodified. Endscrapers and multiple burins are common. Carinated pieces and El Wad points are rare or absent. It is mainly the absence of these elements as well as the emphasis on blade/bladelet production that suggests continuity with the Early Ahmarian assemblage-group (Belfer-Cohen and Goring-Morris 2007). The very latest Masraqan assemblages (i.e., those dating to 17–25 Ka cal. BP) are viewed as "transitional" between Upper Paleolithic and Epipaleolithic.

Levantine prehistorians currently use both terms, Late Ahmarian and Masraqan, for this assemblage-group.

Upper Paleolithic in the Montane Levant

The principal Upper Paleolithic assemblage-group found in the Zagros-Taurus Mountain Range is the Baradostian, which takes its name from a mountain near Shanidar Cave in Iraq (Solecki 1963). Radiometric dates for Baradostian contexts range between 38 and 23 Ka cal. BP. Baradostian assemblages are based mainly on flake production rather than on prismatic blade production, although as in the southern Levant, retouched bladelets and occasional large invasively retouched "Aurignacian" blades do occur. Carinated pieces and multiple burins are common, as are a variety of El Wad points, laterally carinated pieces, and multiple burins (see CUP Website Figure 5.31). Some researchers use the term, "Zagros Aurignacian," for these assemblages (Olszewski and Dibble 1994), reflecting a conviction that there are meaningful typological links between these and "Aurignacian" assemblages from the Levant, Europe, and western Asia.

Upper Paleolithic Chronological Variability

The key elements of the Middle-Upper Paleolithic industrial transition in the Levant were a shift from Levallois parallel cores to volumetric blade cores (elongated platform cores) and a shift away from flake-based to blade/bladelet-retouched tools. Sequences of Middle Paleolithic, "transitional" Emiran, and "fully Upper Paleolithic" assemblages from sites in the Negev and southern Jordan (e.g., Boker Tachtit, Boker, and Tor Sadaf), the Mediterranean Coast (e.g., Üçagizli, Ksar Akil), and the northern Levant (e.g., Umm El Tlel) demonstrate that this was a region-wide transformation in human technological strategies. These assemblages also show that the particular details of this transition varied within the larger region. Most Levantine researchers accept that technological similarities between Emiran and Early Ahmarian assemblages reflect some kind of ancestor-descendant relationship among their authors. There is less consensus about the relationship between Later Middle Paleolithic and Emiran/Early Ahmarian assemblages (Tostevin 2003).

The earliest syntheses of Levantine Upper Paleolithic prehistory envisioned a stage-wise progression of phases (Garrod 1957, Neuville 1934). By the late 1980s, many Levantine prehistorians adopted a model in which there were at least two distinct lithic traditions in the Earlier Upper Paleolithic (Gilead 1991, 1995). The Early Ahmarian was viewed as indigenous, having developed out of local Emiran precursors and continuing into Later Ahmarian and Masraqan. The Levantine Aurignacian was seen as younger and possibly intrusive from the northern Levant and montane western Eurasia (Belfer-Cohen and Goring-Morris 2003). Gilead (1988) has proposed that originally separate Ahmarian and Levantine Aurignacian lithic traditions both merged with one another and differentiated from one another after periods of prolonged contact. This hypothesis of co-traditions remains popular among contemporary researchers, but there are also many disagreements about the attribution of particular assemblages to one or the other of these assemblage-groups. At present, it is difficult to tell whether this difficulty reflects a genuine social process (an actual blurring of social boundaries among prehistoric populations), a taphonomic process (e.g., rapid turnovers in site occupation creating assemblages made up of inputs from different groups), or an artifact of methodology (i.e., differences in the criteria different prehistorians use to attribute particular assemblages to an assemblage group).

Geographic Variation in the Upper Paleolithic

There is little evidence for a significant geographic dimension to Upper Paleolithic variability within the East Mediterranean Levant. Ahmarian and Late Ahmarian/Masraqan assemblages are found across nearly the full length and breadth of the region. Levantine Aurignacian assemblages are somewhat more common in the northern and coastal parts of the Levant, but they occur in southern and interior contexts as well. None of the faunal remains associated with either Ahmarian or Levantine Aurignacian assemblages suggest major differences in their authors' habitat preferences or ecological niches. As with the various kinds of Middle Paleolithic assemblage-groups discussed in Chapter 4, Upper Paleolithic assemblage-groups probably reflect generalist technological strategies pursued by groups that were equally well adapted to coastal woodlands, inland steppe, and the ecotones between them.

V. INTERPRETIVE ISSUES FOR UPPER PALEOLITHIC VARIABILITY

Middle versus Upper Paleolithic Differences in Lithic Technology

The principal contrast between the Upper and Middle Paleolithic stone tool technology is that Levallois core technology is largely replaced by the use of prismatic blade core reduction and other non-Levallois core technologies. Handaxes and other large cutting tools disappear completely. Among retouched tools, there are greater numbers of burins and endscrapers made on blades, backed knives, and truncated blades, as well as pointed artifacts (El Wad points and allied forms) and carinated pieces. The scarcity of heavy-duty tools and pulverizing/grinding equipment in Upper Paleolithic contexts suggests that, as with their Lower and Middle Paleolithic precursors, mobility was a key component in Upper Paleolithic humans' strategies for coping with environmental stresses and resource shortfalls.

Some aspects of the Levantine Upper Paleolithic lithic evidence hint at connections to other regions. The production of carinated pieces, Dufour bladelets, and invasively flaked blades aligns some Upper Paleolithic assemblages with "Aurignacian" assemblages in Europe and western Asia, but Levantine Aurignacian assemblages lack the emphasis on large prismatic blade production seen among these other Aurignacian assemblages (Olszewski and Dibble 2002). The chanfrein method of endscraper retouch finds parallels in North African Upper Paleolithic Dabban assemblages (Iovita 2009). The systematic production of pointed blades seen in Ahmarian assemblages has been likened to that seen in West European Fumanian/Protoaurignacian assemblages (Mellars 2006).

Proposed Changes in Upper Paleolithic Lithic Systematics

Two changes that could make the Levantine Upper Paleolithic lithic evidence more useful would be to reduce some the contingencies in artifact typology and to move systematics and chronostratigraphy away from the "type-site" approach.

There are many more named types of endscrapers (n = 20), and burins (n = 19), truncations and backed pieces (n = 14) than has ever been shown to have probative value in answering larger research questions about Upper Paleolithic variability. In contrast, there seem to be far too few point types (n = 3) than seems reasonable for so long a period. Two of these point types (Emireh and Umm El Tlel points) occur in only the earliest Upper Paleolithic contexts, while all the remaining points are conflated into El Wad points. If, as is generally supposed, many of these El Wad points were projectile armatures, then the lack of variability among these points is unusual. Nearly all the world's recent hunter-gatherers deploy multiple morphologically distinct projectile weapon armatures at the same time. One thinks it likely that more careful scrutiny of morphometric variability among El Wad points will reveal modalities referable to functional or stylistic variation.

Upper Paleolithic systematics relies on the evidence from a single site, Ksar Akil, for its regional chronostratigraphy to an even greater degree than the Middle Paleolithic does on Tabun Cave. As with the Middle Paleolithic, it is unlikely that any one site contains a complete record of regional chronostratigraphy. Archaeological recovery techniques at the Ksar Akil excavations (at least the most recent ones) were better than those Garrod used at Tabun, but questions about selective recovery remain relevant to efforts to match assemblages from meticulously excavated sites to this older evidence. Two of the named lithic industries represented at Ksar Akil, the Emiran/"Transitional" Industry and the Levantine Aurignacian, probably ought to be reassessed. Both were recognized decades ago, and since their initial recognition, many newly discovered assemblages have been assigned to them. There is now so much variability in both of these assemblages that it is worth considering whether a new look at the Upper Paleolithic stone tool evidence justifies retaining them.

6

THE EPIPALEOLITHIC

I. INTRODUCTION

The Epipaleolithic ("Final Paleolithic") Period is recognized mainly in North Africa and southwest Asia. Its specific dates vary within and between these regions but usually encompass the period between the Last Glacial Maximum and the end of the Younger Dryas Period, roughly 20–10 Ka cal. BP. The Epipaleolithic overlaps chronologically with the later Upper Paleolithic of Europe, but it features geometric microlithic technology, which, in Europe, is usually associated with the final Upper Paleolithic (i.e., Magdalenian and Epigravettian) and postglacial Mesolithic industries.

The Epipaleolithic Period in the Levant is dated to between 24.0 and 11.8 Ka cal. BP (Table 6.1). The beginning of the Epipaleolithic Period occurs near the peak of the Last Glacial Maximum (MIS 2). After these peak cold conditions, the Levant grew rapidly warmer and more humid, only to see a reversal to cold and dry conditions during the Younger Dryas event (12.8–11.5 Ka cal. BP) (Bar-Yosef 2011). After 11.5 Ka cal. BP, as conditions grew steadily warmer and more humid, pollen evidence records a steady southward and inland expansion of Mediterranean woodlands at the expense of the steppe-desert. High topographic relief along the coast and flanks of the Rift Valley created a complex mosaic of woodland-steppe ecotones well-suited for stable residential sites for hunter-gatherers. The end of the Epipaleolithic is more or less coterminous with the end of the Younger

Table 6.1. *Chronostratigraphic Summary of the Levantine Epipaleolithic*

Period	Dates BP in Uncalibrated ^{14}C Years	Dates BP in Calibrated Years	Ka cal. BP as used here
Early Epipaleolithic	20,000–14,500	24,000–18,000	24–18
Middle Epipaleolithic	14,500–12,500	18,000–14,900	18–15
Late Epipaleolithic	12,500–10,200	14,900–11,750	15–12

Periodization follows Belfer-Cohen and Goring-Morris (2011).

Dryas and the earliest evidence for hunter-gatherers practicing incipient forms of agriculture and animal husbandry.

Epipaleolithic Human Behavioral Evolution

The major evolutionary changes associated with the Epipaleolithic are population growth and increasing economic intensification. Since at least the 1970s, prehistorians have often referred to the novel ecological features of the Epipaleolithic as the "Broad-Spectrum Revolution" (Flannery 1969), but recent research suggests less of a revolutionary change than a strategic shift within an already broad, if situationally variable, human ecological niche (Finlayson 2009). Throughout much of the world, the period 20–10 Ka cal. BP witnessed increased evidence for residential stability – not so much "sedentism" in the sense of sites being occupied continuously for multiple generations, but instead the placement of residential sites near ecotones, estuaries, and other places where local resource richness enabled multiseasonal occupations (Mithen 2004). This "collector" land-use strategy contrasts with high-residential-mobility "forager" adaptations that seem to have been the mainstays of Pleistocene human settlement patterns (Binford 1968). Mobility is a major constraint on population growth among recent human hunter-gatherers (Howell 1986, Kelly 1995). Residential stability is widely viewed as fueling human population growth across the Pleistocene/Holocene transition (Bender 1978). In the Levant specifically, efforts to prolong human occupations at these favored sites are thought to have led to economic intensification (increased use of previously underutilized foods, such as cereal grasses) and to experiments with animal husbandry. These changes culminated in agriculture, pastoralism, village life, and formal social institutions during the Neolithic Period (Bar-Yosef 2001, Cauvin 2000, Goring-Morris and Belfer-Cohen 2011).

Epipaleolithic Periodization

The taxonomic distinction between Levantine Upper Paleolithic and Epipaleolithic is generally viewed as arbitrary, one based on the appearance of microlithic technology. There are, however, important structural differences between these archaeological periods. Not the least among these differences is sample richness. There are hundreds of known Epipaleolithic sites, and very nearly a hundred of them have been subjected to either controlled excavation or systematic surface collection. Moreover, these sites are spread out over 12,000 years – a period half the duration of the Upper Paleolithic. Vertebrate fossils, plant remains, shells, and architecture are far more commonly preserved in Epipaleolithic contexts. Lastly, the entirety of the Epipaleolithic lies within the effective of radiocarbon dating. In practical terms, these differences mean that hypotheses about contemporaneity and cultural relationships among Epipaleolithic archaeological samples are both more tenable and more testable than they are for earlier prehistoric periods.

Levantine researchers subdivide the Epipaleolithic into three major chronostratigraphic phases (Goring-Morris and Belfer-Cohen 2011) (see Table 6.1). The Early Epipaleolithic (24–18 Ka cal. BP) is seen mainly as a period during which Levantine human adaptations combine a widening ecological niche with high residential mobility. The Middle Epipaleolithic (18–14.5/15 Ka cal. BP) is marked by a wide variation in subsistence and sedentism, with the size and complex architecture of some sites providing evidence for prolonged occupations. The Later Epipaleolithic (14.9–11.8 Ka cal. BP) sees growing evidence for substantial architecture, year-round site occupations, subsistence intensification, domestication of the wolf/dog, and other practices, such as the systematic and in-bulk processing of cereal grains that prefigure Neolithic agricultural practices.

The Epipaleolithic Archaeological Record

The Levantine Epipaleolithic record consists of evidence from more than a hundred named archeological sites of which several dozen have been excavated, dated radiometrically, and published in detail. Many of these sites are parts of larger site-complexes discovered by survey. These sites share the same name, but are differentiated from one another by either Roman or Arabic numerals. This way of naming sites can be confusing; in the Paleolithic, similar naming conventions distinguish different levels of the same site. Table 6.2 lists the most important of these sites/site complexes (see also Figure 6.1). The Epipaleolithic archaeological record is somewhat richer for the southern Levant than for the North. This almost certainly reflects differences in archaeological scrutiny, rather than actual settlement patterns. For much of the Epipaleolithic Period, conditions favoring human occupation would have been far more favorable in the northern and coastal parts of the Levant than in the arid interior. Recent overviews of the Epipaleolithic period and its evidence include Goring-Morris et al. (2009), Bar-Yosef and Belfer-Cohen (2010), and Maher et al. (2012), but several older works remain authoritative (Bar-Yosef and Belfer-Cohen 1989, Bar-Yosef and Valla 1991, Goring-Morris 1995b, Henry 1989, Valla 1995).

Epipaleolithic Lithics References

Microlithic technology is the lithic hallmark of the Epipaleolithic, but this period also saw increased efforts to shape stone by carving and abrasion. Since the 1970s, most descriptions of Levantine Epipaleolithic flaked-stone technology use the type-list for Upper Paleolithic and Epipaleolithic periods recommended by the 1969 London Symposium (Hours 1974). Some more recently published descriptions have enlarged this typology or modified it somewhat for use in local circumstances (e.g. Goring-Morris 1987). Many researchers have augmented the London typology with artifact-types identified by Tixier (1963) among North African assemblages (see Appendix 1).

II. FLAKED STONE TECHNOLOGY & TYPOLOGY

There are many continuities in lithic technology between the Upper Paleolithic and Epipaleolithic periods. To avoid repetition, this chapter focuses mainly on the derived (newly emergent) aspects of the Epipaleolithic evidence.

Table 6.2. *Important Epipaleolithic Sites and Site Complexes by Epipaleolithic (EP) Phases*

Site/Site Complex	Early EP	Middle EP	Late EP	References
SOUTHERN LEVANT				
Urkan e-Rub IIa	+			Hovers et al., (1988)
Kharaneh IV	+			Maher et al., (2012)
Ohalo II	+			Nadel (2002)
Ein Gev Site Complex	+	+		Bar-Yosef (1970)
Wadi Madamagh	+	+		Kirkbride (1958)
Kebara Cave	+		+	Bar-Yosef (1970)
Nahal Oren Cave	+		+	Bar-Yosef (1970)
Wadi Hammeh Site Complex	+		+	Edwards et al., (1988)
Neveh David		+		Kaufman (1989)
Wadi Ziqlab Site Complex		+		Maher et al. (2001)
Hayonim Cave & Terrace	+	+	+	Bar-Yosef (1970, 1991)
Ras en Naqb (South Jordan) Site Complex	+	+	+	Henry (1995c)
Nahal Lavan Site Complex	+	+	+	Goring-Morris (1987)
Shunera Site Complex	+	+	+	Goring-Morris (1987)
SMU Central Negev Sites	+	+	+	Marks (1976c, 1977a)
Wadi Fazael Site Complex	+	+	+	Grossman et al. (1999)
Azraq Site Complex (Uwainid, Azraq)	+	+	+	Byrd (1988), Byrd and Garrard (1992)
Wadi el-Hasa Site Complex	+	+	+	Olszewski (1997)
Lagama Site Complex		+	+	Bar-Yosef and Phillips (1977)
Mushabi Site Complex		+	+	Bar-Yosef and Phillips (1977)
Nahal Nizzana Site Complex		+	+	Goring-Morris (1987)

(continued)

Table 6.2 (*continued*)

Site/Site Complex	Early EP	Middle EP	Late EP	References
El Wad Cave			+	Garrod (1937a), Weinstein-Evron et al., (2008)
Eynan/'Ain Mallaha			+	Valla, et al. (1999)
Har Harif Site Complex			+	Scott (1977) Goring-Morris (1991)
Salibiya Site Complex			+	Bar-Yosef and Gopher (1997), Belfer-Cohen and Grossman (1997)
Hatoula			+	Lechevallier and Ronen (1994)
Shukhbah Cave			+	Garrod and Bate (1942)
NORTHERN LEVANT				
Dour ech-Choueir	+			Hours (1986)
El Kowm (Nadaouiyeh-2)	+			Cauvin and Coqueugniot (1989)
Ksar Akil II	+			Hours (1986)
Yabrud Shelter 3	+	+		Rust (1950)
Jiita Site Complex	+		+	Hours (1986), Copeland (1991b)
Abri Bergy		+		Hours (1986)
Abu Hureyra			+	Olszewski (1986)
Anteilas Cave			+	Copeland and Hours (1971)
Borj Barajne			+	Copeland (1991b)
Mureybit			+	Ibàñez (2008)
Nachacharini Cave			+	Copeland (1991b), Garrard et al., (2003)
Saaide II			+	Schroeder (1991)

Notes: This table divides the North Levant from Southern Levant at approximately 33°N Latitude.

Epipaleolithic Core Technology

The basic aspects of Epipaleolithic core technology, including the range of forms and the terms used to describe them, differ little from those of the Upper Paleolithic (see Chapter 5). Carinated, and narrow-fronted blade cores continue to be used and recognized typologically (Figure 6.2.a–d). Other commonly recognized core types include single-platform cores, opposed-platform cores, change-of-orientation

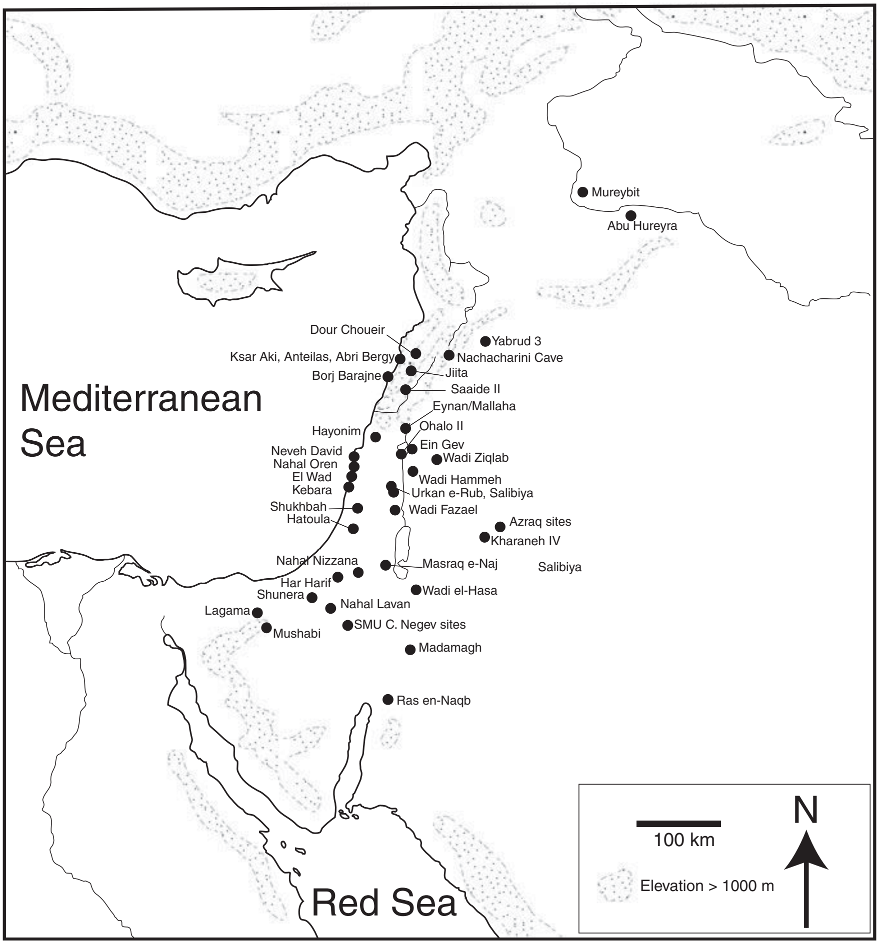


FIGURE 6.1. Map showing important Epipaleolithic sites.

cores, and pyramidal cores (Figure 6.2.e–l). Most Epipaleolithic assemblages also feature small pebble cores.

In core reduction, much emphasis is placed on the production of bladelets. Bladelets are elongated flakes whose length is greater than or equal to twice its width, but not more than 50 mm long and whose maximum width is not more than 12 mm. Many narrow, straight, and consistently shaped bladelets were struck from narrow-fronted cores. These cores' striking platform surfaces were established by detaching thick tablet flakes. The distal convexities and lateral margins of

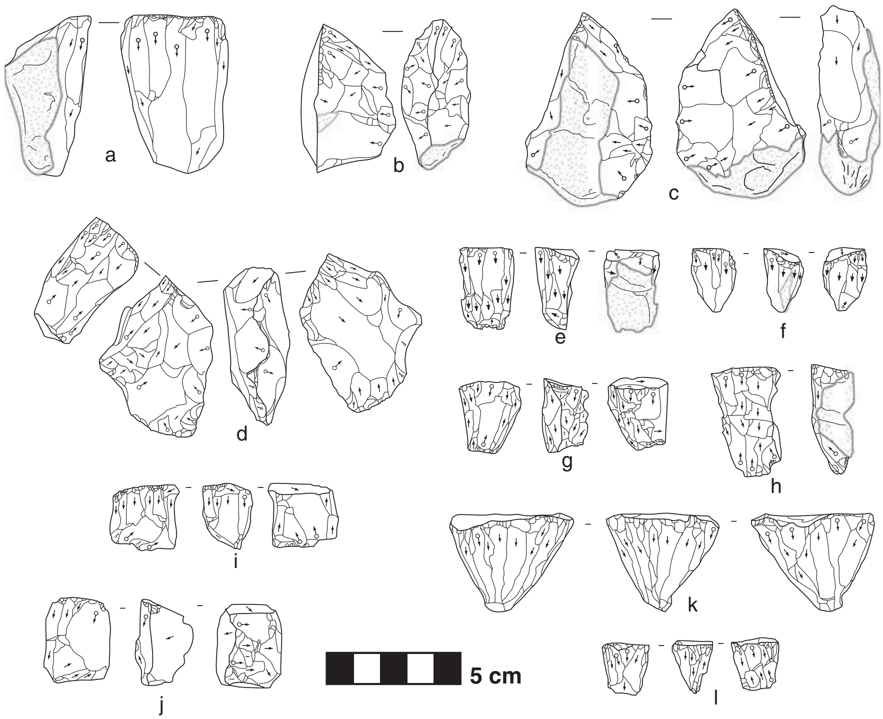


FIGURE 6.2. Epipaleolithic cores. a. broad-fronted core, b. carinated core, c–d, narrow-fronted cores, e–f. single platform cores, g–h. opposed-platform cores, i–j. change-of-orientation cores, k–l. pyramidal cores. *Sources:* Ein Gev I Level 3 (a–c), Ein Gev I Level 4 (d), Rosh Zin (e–g), Rosh Horesha (h–i, k), Abu Salem (j), SMU D5 (l). Redrawn after Bar-Yosef (1970), Henry (1976) Marks (1976d), Marks and Larson (1977), and Scott (1977).

flake-release surfaces on these narrow-fronted cores were controlled by bifacial flaking (Figure 6.3). This strategy of bladelet production is well represented in earlier Epipaleolithic assemblages and somewhat less common in later ones. Narrow-fronted core reduction is not the only method Epipaleolithic knappers used to detach bladelets, but it is one of the more formal and more clearly recognizable set of strategies used for this purpose.

Increased bladelet production had several important consequences. As the size threshold for tool blanks decreased, there was a correlated decrease in the size at which Epipaleolithic cores became too small to furnish useable bladelets. Consequently, Epipaleolithic assemblages contain large numbers of very small cores. A desire for smaller débitage

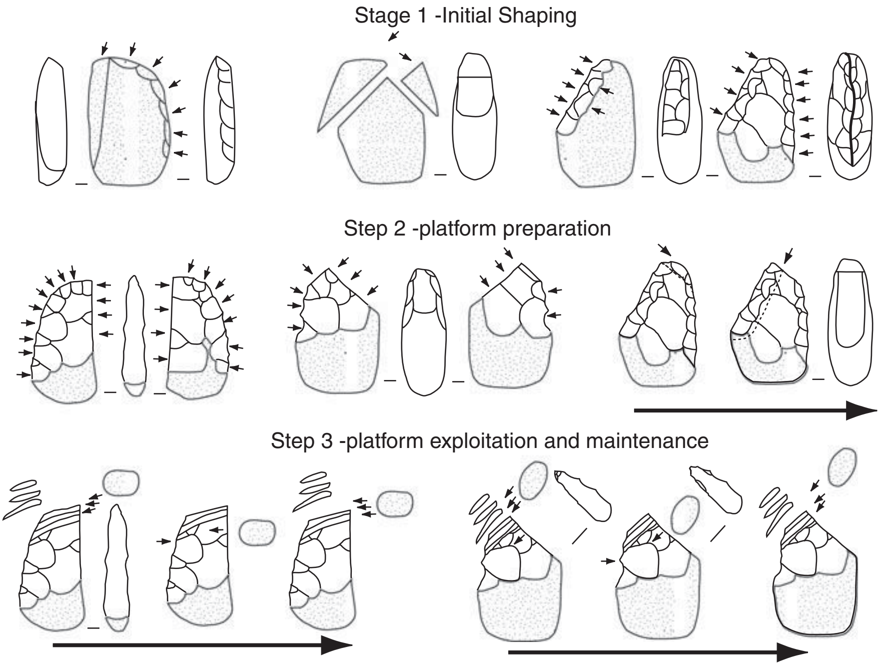


FIGURE 6.3. Schematic of Early Epipaleolithic narrow fronted cores (modified after Bar-Yosef 1970: figure 101). Several of the methods for creating and maintaining carinated blade cores in the Levantine Epipaleolithic. Core preparation follows three steps; (1) initial shaping, (2) platform preparation, and (3) platform exploitation and maintenance. Note that there are several strategies for accomplishing each of these steps.

products meant that smaller pieces of stone, including flakes and flake fragments could be used as bladelet cores. Some Epipaleolithic carinated pieces and multiple burins could have been bladelet cores. Finally, a trend toward using smaller cores increases the chances that separate flake-release surfaces will intersect with one another, creating the appearance of "expedient" or relatively informal cores.

Epipaleolithic Retouched Tools Technology

Most of the methods used to retouch Upper Paleolithic stone tools continued to be used in Epipaleolithic contexts. The main differences include a greater range of typologically significant variation in techniques for retouching, truncating, backing and otherwise modifying blades and bladelets.

Table 6.3. *Types of Epipaleolithic Retouch/Backing*

Retouch Type	Definition
Fine	A line of small (1–2 mm long) feather-terminated fractures on either dorsal or ventral side of the edge. Also known as marginal backing.
Abrupt	Unifacial retouch whose terminations form a straight, sharply-defined ridge or "back," typically on dorsal face, but can occur on ventral as well. Also known as steep backing.
Semi-abrupt	Abrupt retouch that is variable in execution. The distal ends of retouch scars do not form a straight, sharply-defined ridge. May be dorsal or ventral. Also known as semi-steep retouch.
Invasive	Retouch characterized by long (>2 mm) flake scars that propagate more or less parallel the flake surface. May be dorsal or ventral. Also known as flat invasive backing.
Mixed or Irregular	Unifacial retouch that includes fine, abrupt, and/or semi-abrupt retouch along the same edge (dorsal or ventral).
Bipolar	Retouch struck from dorsal and ventral faces of the same edge and that converge on the backed edge. Also known as sur enclume backing.
Alternate	Unifacial retouch that alternates from one side of an edge to the other.
Ouchtata	A series of very small (<1–2 mm long) unifacial flake scars along an edge whose terminations do not form a straight back.
Helwan	Invasive bifacial retouch formed by flakes originating on the backed edge and propagating onto dorsal and ventral faces.
Barajné	Multidirectional backing in which flakes are struck not only from dorsal and ventral faces to form a backed edge but also struck from that backed edge onto the dorsal and/or ventral faces.

Backing and Retouch

The taxonomy of retouch varies widely among Levantine researchers (Brézillon 1977, Marks 1976b, Tixier 1963). To indicate the location of retouch, many researchers use the terms "obverse" (dorsal) and "inverse" (ventral). "Backing" generally refers to retouch that creates a steep (>45°) angle between the dorsal and ventral edges along the lateral margin of a blade/bladelet. Table 6.3 lists and defines the major named kinds of retouch currently recognized in Levantine Epipaleolithic contexts (see Figure 6.4). Most of these kinds of retouch can be created by pressure flaking or by careful percussion flaking on an anvil. Most researchers see variation in retouch as primarily reflecting stylistic, rather than functional, variability.

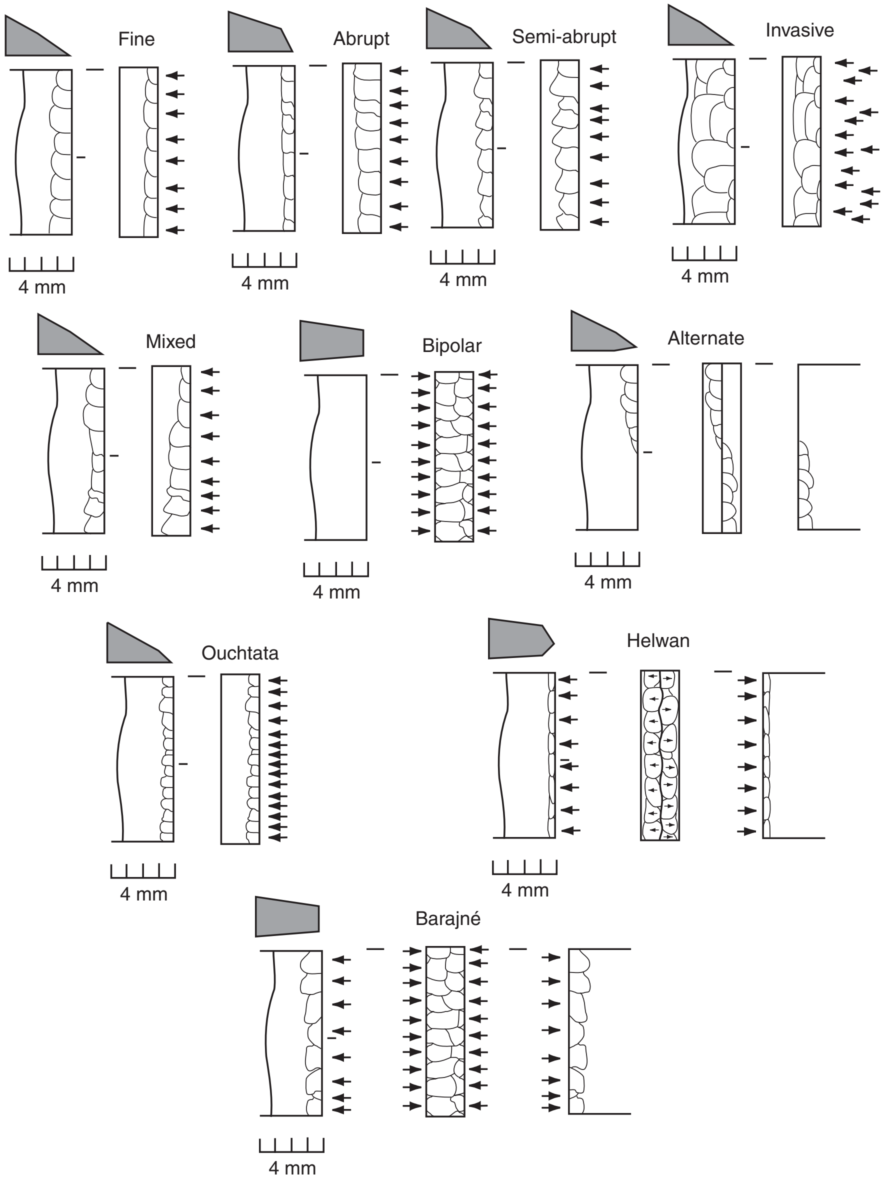


FIGURE 6.4. Modes of retouch recognized in Epipaleolithic typology. *Note:* Fine, abrupt, semi-abrupt, invasive, mixed, and Ouchtata retouch are shown here as on the dorsal face, although they may be either dorsal or ventral.

Truncation

Truncation involves segmenting a blade or bladelet perpendicularly or obliquely to its long axis. Epipaleolithic knappers used two main methods to accomplish this: snapping and the microburin technique. Snapping simply involves initiating a cone or bending fracture at one or both ends of the blade. With thinner blades and bladelets, this can be accomplished by placing the blade across an anvil and exerting compressive stress at one or both ends until a bending fracture occurs. The position of the anvil determines the location where the fracture will occur. A variant of this method entails clamping one part of the blade between two flat pieces of wood (or stone) and exerting bending stress on the exposed portion of the tool. The fracture will initiate at or near the point where the blade is enclosed. Finally, one can truncate a blade by bipolar percussion – by placing the blade on an anvil and then striking the upper side of the blade above where it rests on the anvil. The resulting fracture, usually a Hertzian cone or shear fracture, will form at the point of percussion.

Microburin Technique

The microburin technique creates a (typically oblique) break in a blade or bladelet by making a small notch on one or both lateral edges and expanding them medially until a bending fracture splits the tool into two pieces. (The name "microburin" is actually a misnomer, because the microburin facet is formed by bending or torsion, rather than by a Hertzian cone fracture.) The use of the microburin technique creates several morphologically distinct artifact-types (Table 6.4 and Figure 6.5). The specific form of the microburin fracture can vary widely, depending on the number of notches, their position (dorsal/ventral and relative to one another) and the direction of bending force (dorsal versus ventral), but few typologies make such fine distinctions among these artifacts.

Burination and Burin Products

Burins are common in Epipaleolithic assemblages. Most Levantine prehistorians classify flakes and blades detached by a burin removal in a single category of "burin spalls" or "burin flakes." Burin flakes are differentiated from bladelets largely on the basis of their having a steeply triangular or quadrilateral profile, or from the presence of a

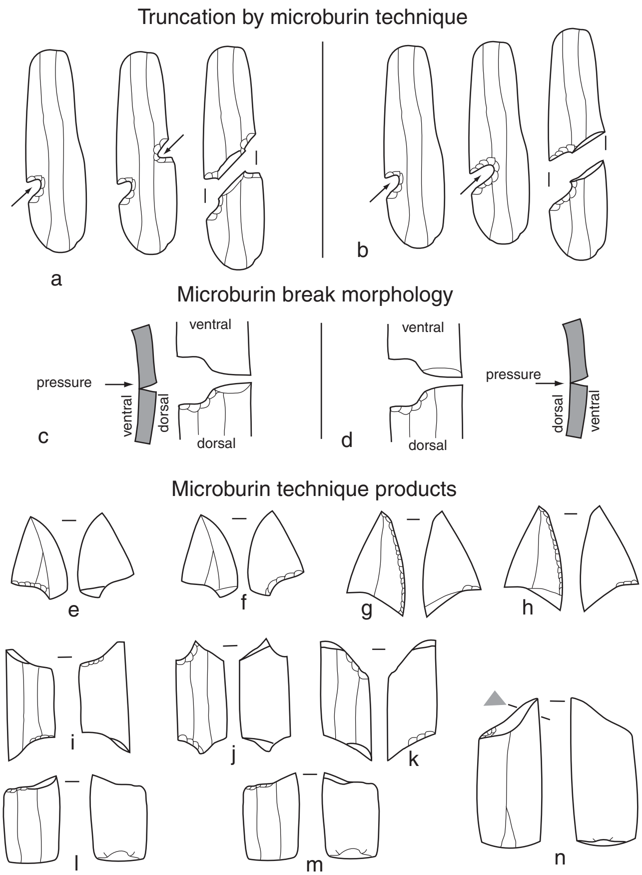


FIGURE 6.5. The microburin technique: a. single-notch microburin truncation, b. double-notch microburin truncation, c. microburin break when break is initiated by pressure on ventral side, d. microburin break when break is initiated by pressure on dorsal side, e-f. distal microburins, g–h. Krukowski microburins, i–k. double microburins, l–m. proximal microburins, n. trihedral pick (*piquant tièdre*).

use-worn, backed, or otherwise damaged edge on their dorsal surface. Although most prehistorians view burin flakes as retouch byproducts, it is possible that Epipaleolithic burin spalls were tools in their own right. Many of them are not much smaller than bladelets from the same assemblage and have sharp edges and points suitable for use in cutting and piercing tasks. The typological category of "multiple burins" may unite functional tools, cores, and artifacts that served both purposes.

Table 6.4. *Byproducts of the Microburin Technique*

Artifact	Description
Distal microburin	Distal blade/bladelet fragment with a microburin scar at its proximal end.
Krukowski microburin	Distal microburin with a retouched/backed lateral edge.
Double microburin	Medial blade/bladelet fragment with a microburin scar at each end.
Proximal microburin	Proximal blade/bladelet fragment with a microburin scar at its distal end.
Trihedral pick (*piquant trièdre*)	Proximal microburin with a sharp trihedral point formed by the intersection of the ventral and dorsal surfaces and the microburin scar.

Epipaleolithic Retouched Tool Typology

As with technology, there is also considerable overlap between typologies of Upper Paleolithic and Epipaleolithic stone tools. In the interest of brevity, this chapter discusses mainly novel artifact categories that are important for Epipaleolithic systematics. In describing these artifact-groups, this chapter follows closely the typology Goring-Morris (1987: appendix II) developed for his analysis of sites from the Negev and Sinai. Goring-Morris' typology recognizes most of the same artifact-types as the London Typology (Hours 1974), and the ones developed by Bar-Yosef (1970), Marks (1976b), and Henry (1995c: 235–238). This typology differs from other typologies in making finer distinctions among artifact-types that are of analytical importance for the Epipaleolithic. It combines some types whose differences have little analytical significance in Epipaleolithic contexts (e.g., numerous perforators and combination tools). Finally, this typology includes several artifact-types recognized since the London 1969 Typology conference. The Goring-Morris typology is currently in wide use in those parts of the southern Levant that have produced the greatest number of dated and well described Epipaleolithic assemblages.

Retouched and Backed Blade Tools

Retouched backed blades feature retouch along some significant portion of their lateral edges. To differentiate retouched blades from bladelets, most Levantine researchers use Tixier's (1963: 9) criterion that backed blades must be more than 50 mm long and 9 mm wide. Most of the typological distinctions made among retouched and backed blades have to do with the extent of retouch and the overall shape of the backed/retouched edge (Table 6.5 and CUP Website Figure 32).

Sickle inserts, a subset of blade tools, are defined on the basis of use-related wear, rather than retouch. Sickle inserts feature a brightly reflective polish on one of their edges, usually the edge opposite the backed edge. This polish is the result of extreme surface abrasion caused by contact with opal phytoliths in the stems and leaves of grasses (Fullagar 1991). Most sickles show this bright polish on only one of their edges – the other edge presumably having been set in mastic or a handle. Although microscopy can aid in the interpretation of sickle polish, its presence or absence can usually be assessed either without artificial magnification or with a hand-lens. Further, more nuanced functional interpretations of sickles require higher magnification microscopy.

Two kinds of Epipaleolithic "points," El Wad points and Falita points, can be grouped with backed blades. Unlike the other "projectile points" (discussed later in this chapter), El Wad and Falita points seem to have no special basal modification for hafting. El Wad points first appear in Upper Paleolithic contexts (see Chapter 5), but they also occur in Epipaleolithic assemblages. Depending on the particular pattern of retouch they exhibit, smaller El Wad points may also be classified as one of several other Epipaleolithic types. The Falita point is a pointed blade with a tip shaped by fine/semi-abrupt retouch, but at least one of its lateral edges is backed by abrupt retouch. Many typologists view the Falita point as a kind of backed blade, rather than as a point in the functional sense.

Retouched Bladelets and Microliths

The term "microliths" refers to backed and/or truncated bladelets, points, geometric and non-geometric pieces, and projectile points. Many of the typological distinctions among Epipaleolithic microliths are based on subtle variation in the placement of retouch. It seems less plausible that these distinctions parallel major differences in artifact function so much as they parallel differences in hafting arrangements and/or culturally conditioned choices among design options.

Table 6.5. *Epipaleolithic Microliths*

I. Microlith Types	Description
I.1 Bladelet with partial fine retouch	Bladelet with fine retouch along part of one lateral edge
I.2 Bladelet with complete fine retouch	Bladelet with fine retouch along the totality of one lateral edge
I.3 Dufour bladelet	Bladelet with twisted or ventrally curved profile and continuous fine or semi-abrupt retouch along its edges, on either dorsal or ventral sides.
I.4 Inversely retouched bladelet	Bladelet with straight profile and (usually fine and partial) retouch on its ventral face.
I.5 Alternately retouched bladelet	Same as I.4, but with alternate retouch on both ventral and dorsal surfaces.
I.6 Partially retouched bladelet	Bladelet with straight profile and partial retouch (of any kind but fine) on dorsal face.
I.7 Completely retouched bladelet	Same as I.6, but with retouch along entire lateral edge.
I.8 Bladelet retouched on both edges	Same as I.6, but with retouch along of both lateral edges.
I.9 Blunt backed bladelet (including splayed)	Bladelet with unretouched distal end that is square or rounded in plan view and one backed lateral edge.
I.10 Pointed backed bladelet	Bladelet with one backed lateral edge that forms a point with the unretouched edge of the opposite lateral edge.
I.11 Pointed backed bladelet with basal modification	Same as I.10, but with invasive retouch on the proximal end.
I.12 Curved pointed bladelet	Pointed backed bladelet whose backed edge is shallowly convex in plan view near its distal end.
I.13 Micropoint	Pointed bladelet whose entire backed edge is shallowly convex in plan view.
I.14 Micropoint with basal modification	Same as I.13, but with invasive retouch on the proximal end.
I.15 Obliquely truncated bladelet (aka Jiita point, Kebara point)	Bladelet with a truncation at its distal end that is aligned obliquely to the long axis of the tool.

I. Microlith Types	Description
I.16 Obliquely truncated and backed bladelet	Same as I.15, but with backing continuing from the most proximal end of the truncation along the same lateral edge.
I.17 Microgravette point	Same as I.15, but points formed by truncations at both end. Backing is abrupt or bipolar.
I.18 Scalene bladelet	Backed and truncated bladelet whose edges approximate the shape of a scalene triangle (e.g., Qalkhan point).
I.19 Scalene bladelet with basal modification	Same as I.18, but with invasive retouch on the proximal end.
I.20 Arch backed bladelet	Backed bladelet whose steeply backed retouched lateral edge is shallowly symmetrical in plan shape.
I.21 Arch backed bladelet with basal modification	Same as I.20, but with invasive retouch on the proximal end.
I.22 La Mouillah point	Proximal bladelet fragment with backing on one lateral edge and a bending fracture scar on its distal end.
I.23 La Mouillah point with basal modification	Same as I.22, but with invasive retouch on the proximal end.
I.24 Ramon point	Backed bladelet with an oblique truncation at its distal end and a backed lateral edge that is shallowly concave in plan view.
I.25 Ramon point with basal modification	Same as I.24, but with invasive retouch on the proximal end.
I.26 Atypical Ramon point	Same as I.24, but with irregular backing or a lateral edge that is not concave.
I.27 Helwan point	Pointed backed bladelet with Helwan retouch along at least part of its lateral edge.
I.28 Double-truncated Helwan point	Truncated bladelet with Helwan retouch on its lateral edge only.
I.29 Helwan bladelet	Bladelet with invasive and bifacial Helwan retouch along one edge.
I.30 Retouched /backed bladelet varia	Any backed bladelet not covered by I.1–30.
I.31 Retouched /backed fragments	Fragments of backed bladelets.

Table 6.6. *Epipaleolithic Geometric Microliths*

J. Geometric Microliths	Description
J.1 Straight truncated and backed	A bladelet with a distal truncation and backed lateral edge that intersect at a right angle.
J.2 Rectangle	Same as J.1, but with a proximal truncation also aligned at right angles to the backed edge.
J.3 Trapeze/rectangle	Same as J.2, but proximal truncation is aligned obliquely.
J.4 Proto-trapeze	Backed bladelet with an oblique distal truncation.
J.5 Trapeze	Backed bladelet with distal and proximal oblique truncations.
J.6 Asymmetrical trapeze A	Same as J.5, but with one long and one short truncation and parallel lateral edges.
J.7 Asymmetrical trapeze B	Same as J.5, but with one long and one short truncation and non-parallel lateral edges.
J.8 Trapeze with one convex end	Same as J.5, but with convex truncations.
J.9 Helwan lunate	Circle segment with invasive bifacial/Helwan retouch on the entirety of its backed edge.
J.10 Atypical Helwan lunate	Same as J.9, but with incomplete Helwan retouch (e.g., at center but not ends of backed edge).
J.11 Lunate/crescent	Circle segment formed by unifacial backing of one lateral edge, and distal and proximal ends.
J.12 Atypical lunate	Lunate on which part of the backed edge is straight, rather than curved.
J.13 Isosceles triangle	Backed piece in the shape of an isosceles triangle.
J.14 Atypical triangle	Triangle with incomplete backing.

Backed and/or truncated bladelets and points ("microliths" in the Goring-Morris Typology) are bladelets that retain enough of their proximal end to identify their technological orientation. Where the proximal end has been retouched away, such artifacts are identified either as a distinct type "with basal modification" or as "geometric microliths" (discussed later in this chapter.) Pieces whose distal ends have been retouched into a convergent tip are classified as points. Table 6.6 lists these Epipaleolithic tools (see Figure 6.6).

The "retouched/backed bladelet varia" category in the Goring-Morris typology subsumes several rare forms of named types recognized by the London and other typologies. These include shouldered

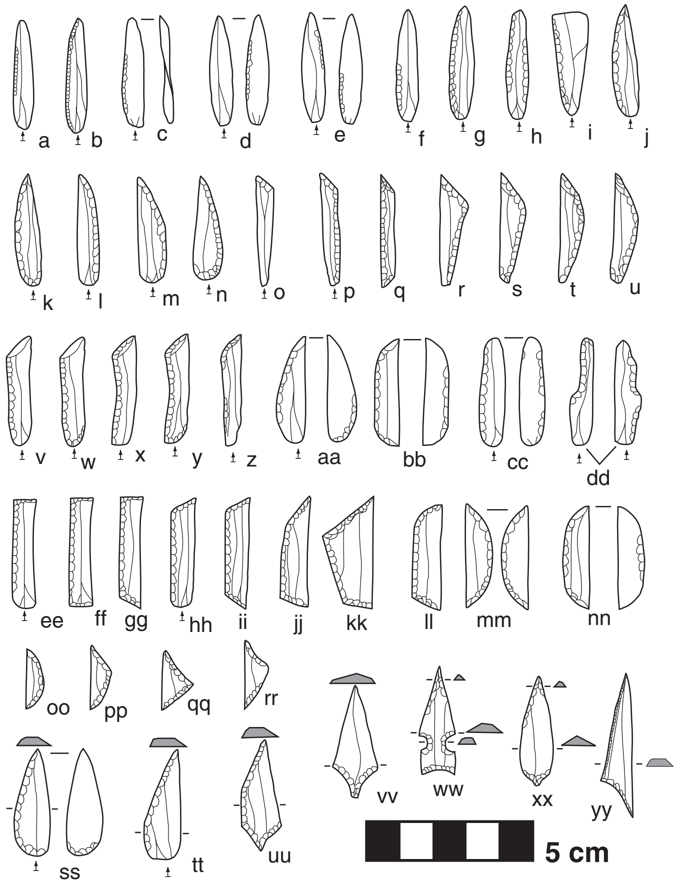


FIGURE 6.6. Epipaleolithic microliths and projectile points. Non-geometric microliths (a–dd), geometric microliths (ee–rr), and projectile points (ss–yy). Specific types: a. bladelet with partial fine retouch, b. bladelet with complete fine retouch, c. Dufour bladelet, d. inversely retouched bladelet, e. alternately retouched bladelet, f. partially retouched bladelet, g. completely retouched bladelet, h. bladelet retouched on both edges, i. blunt/splayed backed bladelet, j. pointed backed bladelet, k. pointed backed bladelet with basal modification, l. curved pointed bladelet, m. micropoint, n. micropoint with basal modification, o. obliquely truncated bladelet (aka Jiita point, Kebara point), p. obliquely truncated and backed bladelet, q. microgravette point, r. scalene bladelet, s. scalene bladelet with basal modification, t. arch backed bladelet, u. arch backed bladelet with basal modification, v. La Mouillah point, w. La Mouillah point with basal modification, x. Ramon point, y. Ramon point with basal modification, z. atypical Ramon point, aa. Helwan point, bb. double-truncated Helwan point, cc. Helwan bladelet, dd. retouched /backed bladelet varia, ee. straight truncated and backed rectangle, ff. rectangle, gg. trapeze/rectangle, hh. proto-trapeze, ii. trapeze, jj. asymmetrical trapeze A, kk. asymmetrical trapeze B, ll. trapeze with one convex end, mm. Helwan lunate, nn. atypical Helwan lunate, oo. lunate/crescent, pp. atypical lunate, qq. isosceles triangle, rr. atypical triangle, ss. Shunera point, tt. Proto-Harif point, uu. Harif point, vv. Ounan point, ww. Khiam point, xx. Abu Maadi point, yy, Qalkhan point. *Sources:* Schematic drawings: a–xx after Goring-Morris (1987), and yy after Henry (1995c).

Table 6.7. *Epipaleolithic Projectile Points*

K. Projectile Points	Description
K.1 Shunera point	Pointed curve-backed bladelet with invasive retouch on its base. (Essentially a large I.14 micropoint with basal modification [I.14]).
K.2 Proto-Harif point	Point with a long oblique distal truncation and a shorter backed lateral edge.
K.3 Harif point	Point formed by a long oblique distal truncation, a backed lateral edge, and convergent oblique truncations at its base.
K.4 Ounan point	Pointed blade, bladelet, or flake with convergent oblique truncations at its base.
K.5 Khiam point	Point with side-notches and a concave base. There may be dorsal or ventral shaping retouch at the tip.
K.6 Abu Maadi point	Point with minor shaping retouch at its distal end and a short convergently backed/retouched tip at its proximal end.

backed blades, backed pieces with "gibbosities" (retouched convex projections), and bladelets with "Barajne" retouch.

Developed for use with assemblages from the Negev and Sinai, the Goring-Morris typology does not recognize several point types found mainly in the northern Levant and Jordan, such as the Dour Choueir bladelet. Known mainly from the northern Levant, Dour Choueir bladelets are truncated at their distal and proximal ends by inverse (ventral) retouch and/or are inversely retouched along their lateral edges. Qalkhan points, found mainly in Jordan, are roughly scalene triangles with a concave basal truncation. Although one could treat them as scalene bladelets, Henry (1995c: 223–225) argues for recognizing the Qalkhan point as a distinct tool type.

Geometric pieces are blade, bladelet, and flake fragments that have been backed and/or truncated in such a way that their plan shape approximates one of several distinct geometric forms – rectangles, trapezoids, triangles, or segments of circles (see Table 6.7). For this last kind of geometric form, most Levantine prehistorians use the term, "lunate" rather than "crescent." Geometric pieces are thought to have greater diagnostic value for assessing inter-assemblage relationships than non-geometric pieces.

Table 6.8. *Epipaleolithic Retouched/Backed Blades and Sickle Inserts*

Retouched/Backed Blade Types	Description
E.1 Partially retouched	Blade with backing retouch along part of one lateral edge.
E.2 Completely retouched	Blade with backing retouch along the totality of one lateral edge.
E.3 Retouched on both edges	Blade with backing retouch along the totality of both lateral edges.
E.4 Inversely/alternately retouched	Blade with backing retouch on either the ventral side of one or both lateral edges, or alternatingly (ventral and dorsal) on one or both lateral edges.
E.5 Helwan blade	Blade with bifacial invasive "Helwan" retouch along one edge.
E.6 Backed knife	Blade with steep abrupt retouch along one relatively straight lateral edge.
E.7 Curved backed knife	Same as E.6, but the lateral edge curves medially at its distal end, forming a sharp tip.
E.8 Retouched/backed blade varia	Backed blades not covered by E.1–6.
E.9 Backed/retouched (blade) fragments	Fragments of retouched/backed blades.
F.1 Unretouched sickle blade	A blade with sickle polish along one lateral edge.
F.2 Sickle blade on backed blade or bladelet	Backed blade or bladelet with sickle polish.
F.3 Sickle blade on curved backed blade	Curved backed blade with sickle polish.
F.4 Sickle blade on Helwan blade or bladelet	Blade or bladelet with Helwan retouch on one edge and sickle polish on the other.

Epipaleolithic "projectile points" are symmetrical pointed pieces that have been shaped by differing combinations of retouch, truncation, and backing (see Table 6.8). The crucial feature that unites them is that they have some degree of basal modification, apparently to facilitate hafting. Projectile points, together with geometric pieces, and some backed and/or truncated bladelets are thought to have been used as armatures for projectile weapons, mounted variously as either tips, barbs, or with their unretouched edges projecting outward from the sides of weapon shafts (Yaroshevich *et al.* 2010) (see CUP Website

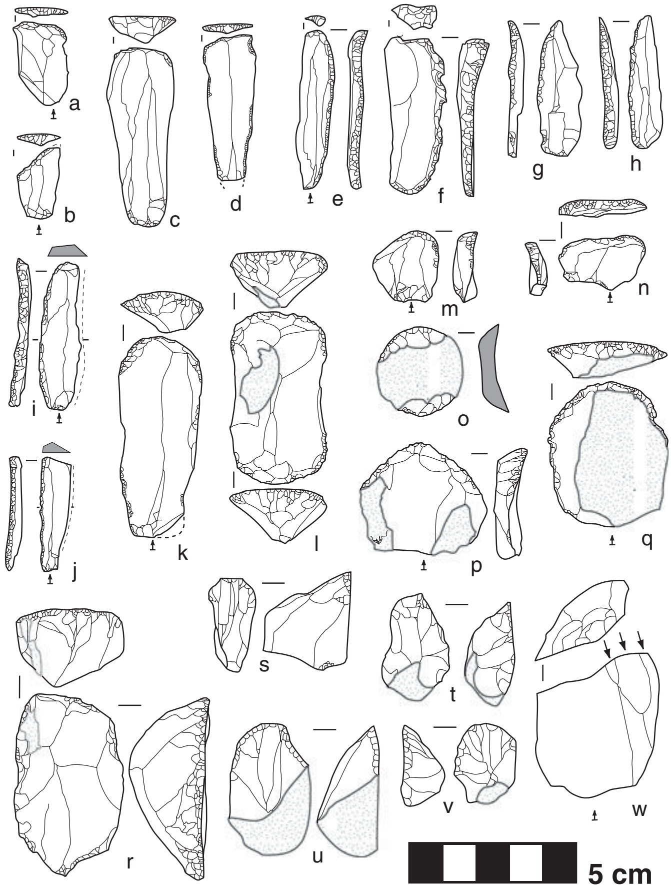


FIGURE 6.7. Epipaleolithic retouched tools (1 of 2): a–d. truncations, e–h. backed bladelets, i–j. sickle inserts (broken line indicates polished edge), k–q. scrapers, r–v. carinated pieces, w. laterally carinated piece. *Sources:* SMU K6/K7 (a), SMU G8 (b, c, g), Abu Salem (d, f, h–n, p–q), Rosh Horesha (e), Hayonim Level C (o, s–w), SMU D5 (r). Redrawn after Bar-Yosef (1970), Marks (1976d), Marks and Larson (1977), Marks and Simmons (1977), and Scott (1977).

Figure 33). Whether particular kinds of points functioned as dart tips, arrowheads, or both remains unknown.

In addition to backed blades, most Epipaleolithic assemblages contain a range of additional retouched tool types, including truncations, scrapers, carinated pieces, burins, perforators, and combination pieces (Figures 6.7–6.8 and CUP Website Figure 34). As in Upper Paleolithic assemblages, the sizes of these artifacts range widely, but in

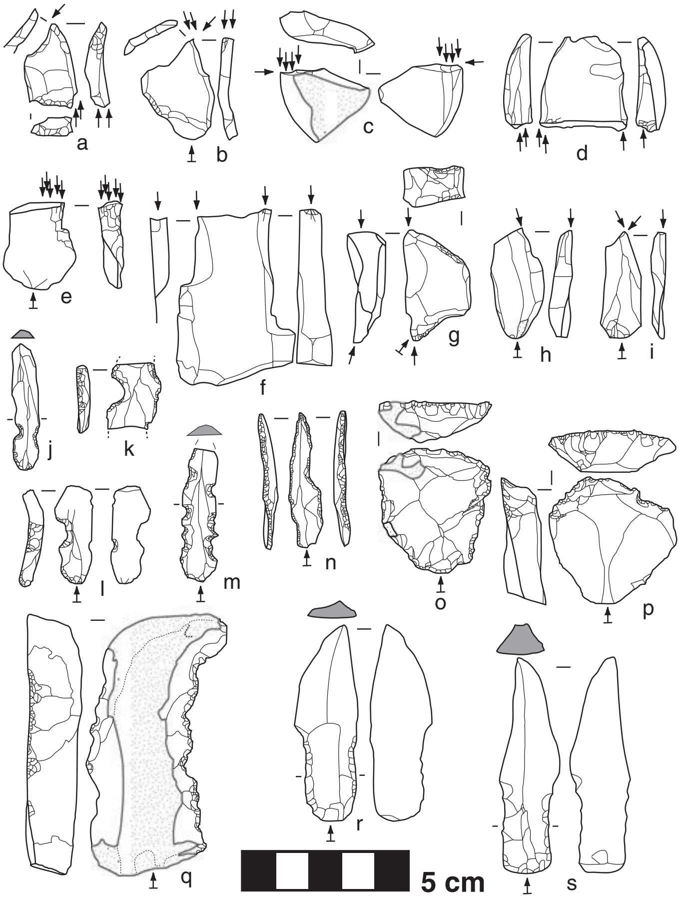


FIGURE 6.8. Epipaleolithic retouched tools (2 of 2): a–i. burins/carinated pieces, j–m. notches, n. perforator, o–p. denticulated scrapers, q. large denticulate, r–s. tanged pieces. *Sources:* Hayonim C (a–c, f), Rosh Zin (d–e, g, j–k), Rosh Horesha (h–i, n), SMU G8 (l), SMU K6/K7 (m, p), SMU D5 (o), Abu Salem (q), Mureybit ID and IB (r–s). Redrawn after Bar-Yosef (1970), Cauvin (1991), Henry (1976), Marks (1976d), Marks and Larson (1977), Marks and Simmons (1977), and Scott (1977).

keeping with the overall trend toward microlithization, Epipaleolithic examples feature greater numbers of smaller tools.

Lames/pieces à manchure are often identified in Epipaleolithic assemblages, but less so in Upper Paleolithic ones. These are blades or flakes with concentrated but irregular edge-damage on their lateral edges. Because this kind of damage commonly results from post-depositional processes, such as trampling, such artifacts are often excluded from tabulations of retouched tools.

Epipaleolithic assemblages often contain scrapers and denticulates made on large thick blades and cortical flakes. There are few consistent patterns among these tools other than their mode of retouch. As such, they are generally viewed as tools made on-the-spot and left behind at habitation sites, rather than as components of curated personal gear.

Heavy-Duty Core Tools

Heavy-duty core tools from Levantine Epipaleolithic, Neolithic, and later contexts are also sometimes called "stone axes/adzes" or "celts." Epipaleolithic celts are elongated and shaped by steep and invasive retouch, which may be either unifacial or bifacial. Lateral edges are steeply retouched and use-related wear is concentrated at one or both ends of their long axis. Barkai (2005) has made the most extensive analysis of these artifacts, and most of the terminology used to describe them here is adopted from this work. Epipaleolithic contexts feature two main types of heavy-duty core-tools, picks and chisels, as well as a residual group of tools that show no clear pattern to their morphological variation (Figure 6.9).

Epipaleolithic picks (like their Lower Paleolithic counterparts) are relatively large tools, more or less triangular in shape. They were frequently made on elongated pebbles or cobbles, as can be seen from remains of cortex at their wider proximal end. The distal end is thick, heavily retouched, and often triangular in cross section. Generally, picks exhibit a wide range of morphological variability, a property that may reflect their being minimally modified from cobbles/pebbles.

Chisels are elongated pieces, bifacially, trifacially, or even quadrahedrally flaked. Distal-proximal cross sections are either angular or plano-convex. In medio-lateral cross section they are roughly trapezoidal or triangular. The working edge at the distal end of a chisel is usually narrow, or at least not much wider than the maximum width of the tool. Blunting retouch, and occasional evidence of percussion on the proximal ends of these tools suggests they may have been driven by percussion during use. The richest and best-documented group of Epipaleolithic picks is a set of about four dozen artifacts from the Natufian levels of Hayonim Cave. These artifacts exhibit a substantial degree of standardization.

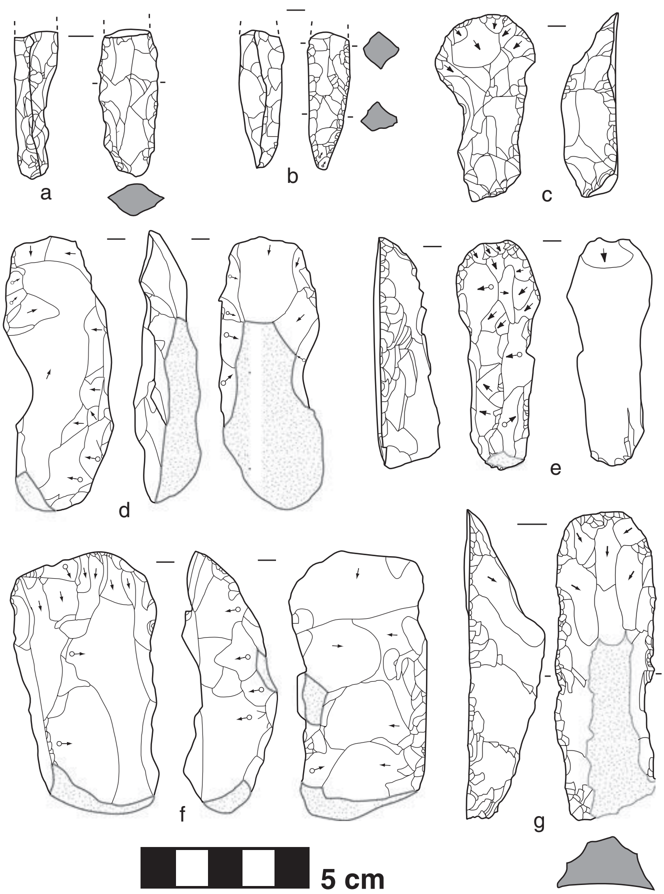


FIGURE 6.9. Epipaleolithic celts (picks, adzes, chisels, gouges). a-b. proximal fragments of chisels, c–g. chisels/adzes. *Sources:* Hayonim Cave B (a–b), Mureybit IA and IB (c, e), Abu Hureyra 1 (c–f), Mureybit (g). Redrawn after Bar-Yosef and Goren (1973), Cauvin (1991), Moore et al. (2000), and Sánchez Priego (2008).

Chisels, and to a lesser extent picks, are generally seen as woodworking tools. There is no clear consensus on whether they were hafted, although the concave lateral edges on some specimens suggest this possibility. Their appearance in later Epipaleolithic contexts is plausibly linked to the carpentry necessary for more substantial architecture. In ethnographic contexts, stone tools similar to chisels and picks have also been observed as hand-held tools used in stone-carving (Hayden 1979). Although later Epipaleolithic people plainly carved stone into useful implements (see discussion later in this chapter), there is no clear evidence that picks or chisels were tools dedicated to stone carving.

Overall, Epipaleolithic contexts feature relatively few heavy-duty tools. Published accounts and illustrations of these tools suggest they do not, as a group, conform to the same highly stereotyped patterns of artifact production and curation that one sees in Neolithic and later contexts.

III. GROUNDSTONE TOOLS

Groundstone Technology

The term "groundstone" implies shaping primarily by abrasive processes, and in this, it is something of a misnomer. Groundstone tools were shaped by a combination of fracture and abrasion. Most of the groundstone tools found in Epipaleolithic contexts (as well as those dating to later periods) were made of limestone or basalt. Although Pleistocene hominins occasionally knapped these materials, neither limestone nor basalt has particularly good conchoidal fracture properties. Striking these materials with a stone hammer usually results in multiple and incomplete Hertzian and shear fractures concentrated around the point of loading. These small fractures, or comminution, weaken the tensile strength of the surface of the rock. Abrasion can then be used to dislodge rock particles bounded by these small fractures. Creating a concavity or otherwise altering the surface of such a rock can be accomplished by repeated cycles of focused percussion and abrasion (pecking and grinding) (see CUP Website Figure 35).

Typology of Groundstone Tools

Groundstone tools occur in many, but not all Epipaleolithic assemblages. (Levantine Neolithic groundstone assemblages are more varied than Epipaleolithic assemblages, and to avoid repetition, groundstone tools are discussed more fully in Chapter 7.) Epipaleolithic groundstone tools can be discussed in terms of three major artifact-categories: pulverizing equipment, grooved/perforated stones, and stone vessels (Wright 1992).

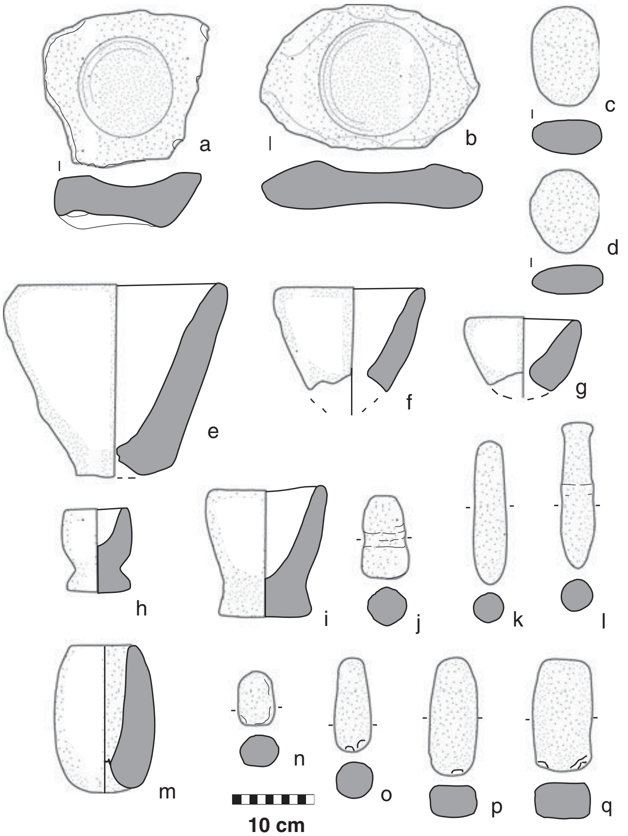


FIGURE 6.10. Epipaleolithic grinding stones, handstones, mortars, and pestles. a–b. grinding stones, c–d. handstones, e–i, m. mortars, j–l, n–q. pestles. *Sources:* Jayroud 3 (a), Jayroud 9 (b), Wadi El Hammeh 27 (c–d, h–l), Hefzibah (e–g, q), Hayonim Cave (m), Givat HaEsev (n–p). Redrawn after Bar-Yosef and Goren (1973), Cauvin (1991), Edwards (1991), Goring-Morris (1995b).

Pulverizing Equipment

Pulverizing equipment encompasses tools whose abraded surfaces appear to have been used to crush ("pulverize") small hard particles of other substances. Microwear and residue analysis suggest these substances included nuts and seeds, but traces of mineral pigments, specifically red ochre, have also been reported. There are five major morphological groups of these tools: grinding stones, handstones, mortars, pestles, and bedrock installations (Figure 6.10–6.12).

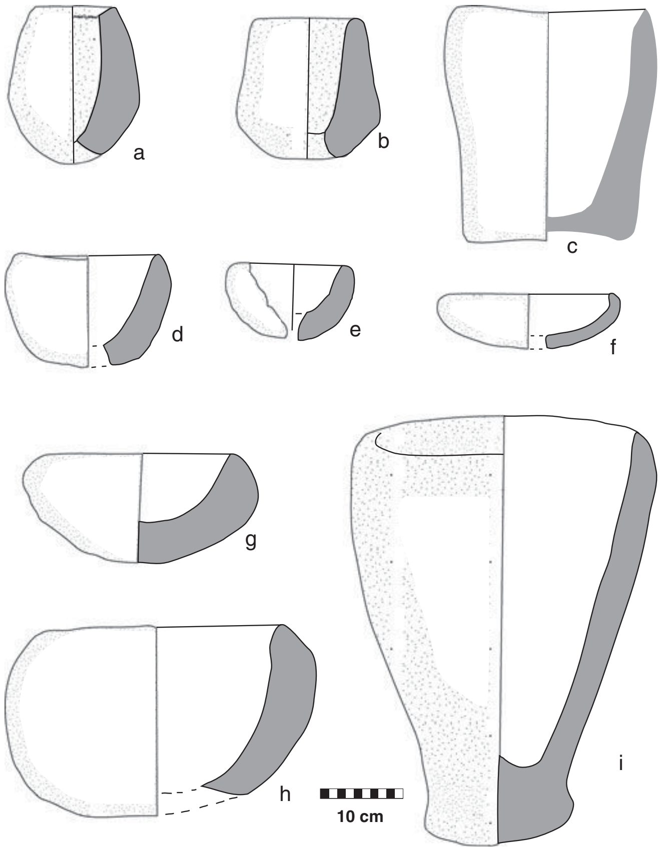


FIGURE 6.11. Epipaleolithic mortars and stone bowls. a–d. i mortars, e–h. stone bowls. *Sources:* Hayonim Cave (a, b, d, i), Ein Gev I (c, h), Givat HaEsev (e), Haon (e), Neveh David (g). Redrawn after Bar-Yosef and Goren (1973), Goring-Morris (1995b).

Grinding stones (also known as "querns") are objects with at least one shallow concave surface with abrasive traces aligned in either circular or linear patterns (see Figure 6.10 a–b). The concavity is usually round or oval in plan view.

Handstones are pebbles or cobbles with one or more convex or flat abraded surfaces (see Figure 6.10.c–d). Handstones are thought to have been used in concert with grinding stones. Where there is a sharply defined boundary between the abraded and unabraded surfaces of handstones, this likely reflects prolonged use. The unabraded parts of handstones opposite the abraded area are usually convex in cross section.

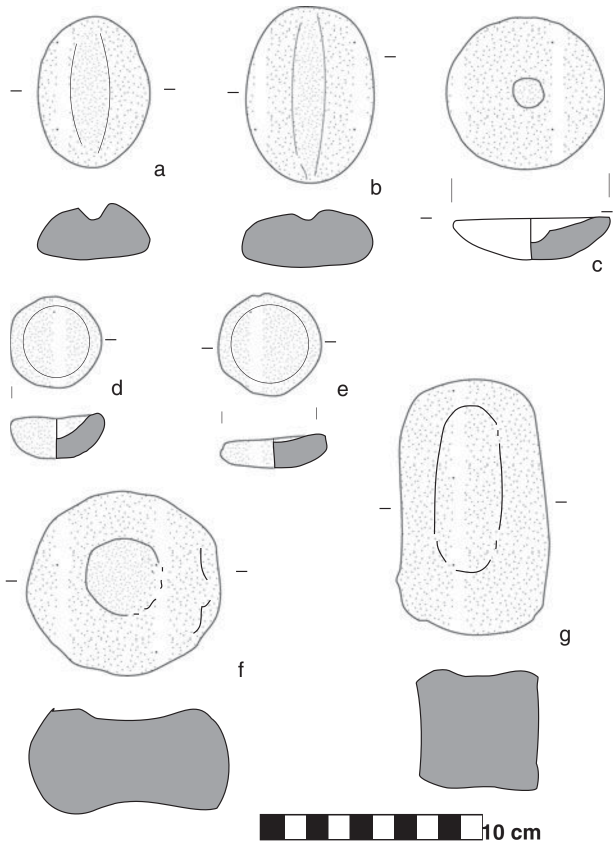


FIGURE 6.12. Epipaleolithic grooved stones, stone bowls, pitted stones. a–b. grooved stones, c–e. small stone bowls/plates, f–g. pitted stones. *Sources:* Wadi El Hammeh 27 (a–e), Ein Gev I (f–g), Edwards (1991), Goring-Morris (1995b).

Mortars have relatively narrow, deep concavities shaped by repetitive pounding and grinding (see Figure 6.10.e–i, m, 6.11.a–c, i). In some cases, the concavity extends completely through the rock, leaving an opening at the bottom. Whether this perforation is an aspect of original tool design, a consequence of use, or both, remains unknown. Some recent human groups attached such perforated mortars to wooden slabs so that the focal point for percussion is resilient and less likely to split the mortar. Significant numbers of Epipaleolithic mortars have been extensively modified so that they have flared bases (presumably to stabilize the tool during use) and smoothed sides (probably to facilitate careful handling).

Pestles are elongated cylindrical pieces of stone with traces of repeated percussion (fractures or comminution) at one or both ends (see Figure 6.10.j–l, n–q). In some cases, the worn end is rounded, in others it is flat, or even concave, suggesting there were differences in the ways pestles were used. Ethnographic analogy and wear analysis suggest pestles were used in concert with mortars to crush seeds by percussion (Kraybill 1977).

Rare examples of combination grinding/stone mortars feature a hemispherical depression (or several of them) abraded into the surface of a grinding stone. These artifacts are usually interpreted as resulting from recycling of discarded grinding stones as mortars, rather than as dual-purpose instruments.

Epipaleolithic sites located near bedrock outcrops often feature rock-cut installations with pounded and abraded concavities similar to those seen in portable grinding stones and mortars (see CUP Website Figure 36). Eitam (2009) has developed the most detailed classification of these features. The most common forms are either single or groupings of shallow hemispherical depressions 10–20 cm in diameter, deep cone-shaped depressions (bedrock mortars), and broad and shallow depressions that are roughly circular in plan view. Each of these three forms can occur either by themselves or in combination with one another.

Grinding stones, mortars, and pestles from ethnographic and archaeological contexts in Africa, Asia, Australia, and the Americas are often linked to in-bulk processing of hard arboreal nuts and the seeds of cereal grasses (Kraybill 1977). Their Levantine Epipaleolithic counterparts are also usually interpreted in this way (Peterson 1999, Wright 1994).

Grooved and Perforated Stones

Grooved stones are pebbles or cobbles with a linear concavity at least three times longer than it is wide (Figure 6.12.a–b). The groove is usually around a centimeter in diameter. Wright's (1992) typology identifies these artifacts as "shaft straighteners" on the basis of analogy with ethnographic artifacts used to straighten the wooden shafts of spears, darts, and arrows. Grooved stones are considered categorically distinct from stone slabs and pebbles with narrow incisions. These latter artifacts are thought to reflect either use as a cutting surface or symbolic artifacts.

Perforated stones are artifacts in which a hole has been drilled through the stone from one side to the other. In Wright's typology, the dividing line between these artifacts and perforated stone beads is not clearly specified. Epipaleolithic examples of larger perforated stones typically show few other substantive modifications to their form. This suggests their perforations may have been affected to allow them to be suspended, rather than to provide an attachment for a lanyard or some other aid to prehension during use. Similar perforated artifacts from later phases of Levantine prehistory and proto-history are interpreted as loom weights or mace-heads. Epipaleolithic perforated stones may have had similar functions.

Stone Vessels/Bowls

Stone vessels or bowls are groundstone objects in which the interior concavity is expanding or straight-walled rather than conical in cross section (Figure 6.11.d–h). Nevertheless, stone vessels/bowls and mortars grade into one another. Stone vessels are not particularly large, and it seems more reasonable to view them as related either to food preparation or the preparation of other substances (pigments or mastic, perhaps) rather than as storage or serving vessels. Fragments of stone vessels and/or mortars occasionally feature incised decorative patterns. Although it is possible some stone bowls were used as cooking vessels, most are made of rocks (such as limestone or basalt) that disintegrate with repeated heating and cooling.

Variation among Epipaleolithic Groundstone Tools

In Wright's (1991, 1993, 1994) surveys of Epipaleolithic groundstone tools, the most common forms are pestles, bedrock mortars, stone vessels, and handstones (Table 6.9). All groundstone tools are far more common among Later Epipaleolithic contexts (more than 45 percent of assemblages) than they are among Early or Middle Epipaleolithic assemblages (approximately 15 percent). Mortars and pestles appear particularly closely associated with Later Epipaleolithic Natufian assemblages. Both mortars and pestles become less common in Neolithic contexts.

Table 6.9. *Occurrence of Groundstone Tools in Epipaleolithic Assemblages*

Period (n assemblages)	Groundstone Present (%)	Groundstone Tools	Quern/ Grinding Slab	Handstone	Mortar	Bedrock Mortar	Pestle	Stone Vessel	Grooved Stone	Perforated Stone	Celt	Other
Early Epipaleolithic (78)	12 (15)	25	2	4	6	1	5	1	1	1		8
Middle Epipaleolithic (178)	27 (15)	57	3	15	9	2	9	8			1	14
Early–Middle Natufian (35)	17 (49)	683	14	75	38	8	269	149	39	6	1	98
Late Natufian (47)	23 (49)	779	15	73	32	386	122	90	23	7		55
Total (338)	79 (23)	1544	34	167	85	397	405	248	63	14	2	175

Source: Wright (1994).

IV. EPIPALEOLITHIC INDUSTRIES

Epipaleolithic industrial variability in the East Mediterranean Levant has often been described in terms of a simple sequence running from Kebaran to Geometric Kebaran to Natufian industries/"cultures." This unilinear sequence reflects findings from sites located along the Mediterranean Coast and the Jordan Rift Valley. Research since the 1970s, particularly surveys focused on the Negev, Sinai, and western and southern Jordan, has resulted in the recognition of additional assemblage-groups, as well as a more nuanced perception of internal variation among Kebaran and Natufian industries. Consequently, many Levantine prehistorians now describe Epipaleolithic variability in terms of a three-part chronostratigraphic framework within whose divisions there are multiple named lithic entities (Table 6.10). For lists of selected archaeological contexts representing particular named Epipaleolithic assemblage-groups, see Table 6.11. The Epipaleolithic of the Montane Levant is not well documented (Düring 2011), and cannot yet be easily integrated into the sequence for the East Mediterranean region. Many of the differences among these assemblage groups revolve around variations in the kinds and relative frequencies of geometric microliths and whether or not (and how) the microburin technique was applied in microlith production (Table 6.12).

Table 6.10. *Levantine Epipaleolithic Assemblage-Groups by Period*

Period	Ka cal. BP	Assemblage-Groups
Early Epipaleolithic	24–18	Kebaran, Nebekian, Qalkhan, Nizzanan, Early Hamran
Middle Epipaleolithic	18–15	Geometric Kebaran, Middle-Late Hamran, Mushabian, Madamaghan, Ramonian
Late Epipaleolithic	15–11.6	Natufian, Terminal Ramonian & Harifian

Periodization follows Belfer-Cohen and Goring-Morris (2002).

Early Epipaleolithic (24–18 Ka cal. BP)

Early Epipaleolithic assemblage-groups include the Kebaran, Nebekian, Qalkhan, Nizzanan and Early Hamran. (Masraqan/Late Ahmarian assemblages, which are treated by some researchers as later

Table 6.11. *Selected Archaeological Contexts Representing of Named Epipaleolithic Assemblage-Groups. Attributions follow Bar-Yosef (1970), Bar-Yosef and Phillips (1977), Goring-Morris (1987, 1995b), Henry (1995a), Hours et al. (1994), and Marks (1976c, 1977a)*

Assemblage-Group by Period	Representative Assemblages
Early Epipaleolithic	
Kebaran	Dhour ech-Choueir
	Ein Aqev (D31) Levels 6–9
	Ein Gev Sites I, II
	Fazael III Levels 4–6
	Hayonim Cave Level Cb-Ce
	Jiita II, Levels 1–5
	Jiita III, Levels 1–2
	Kebara Cave Level C
	Kharaneh IV, Trench 1, Levels 4–7
	Ksar Akil II
	Nahal Hadera Levels 1–2
	Nahal Hadera V, Levels 4–6
	Nahal Oren Level 9/G2-G3
	Shunera XVII
	Urkan e-Rub II
	Wadi Hammeh 26
Nebekian	Yabrud III Levels 6–7
	Jilat 6 Lower
	Uwaynid 14 Lower
	Uwaynid 18 Upper
	Wadi Madamagh Levels A1-A2
	Tor Hamar C
	J431
Early Hamran	Jebel Hamra (J201)
	Jebel Mishraq (J504)
	Jebel Muheimi (J520)
	Henry's Sites J21, J22
	Wadi Humeima (J406b)
Nizzanan	Azariq IX
	Ein Gev IV
	Hamifgash IV
	Kharaneh IV
	Wadi Jilat 6 (Wadi Dhobai K)
Qalkhan	Aarida
	El Kowm I
	Juwai

Assemblage-Group by Period	Representative Assemblages
	Tor Hamar (J431) Level E-2
	Uwaynid sites 14, 18
	Wadi Humeima Sites J405. J406b lower, Henry's Site J407
	Wadi Jilat 6 Middle
	Yabrud III, Levels 4–5
	Nahal Lavan 1010S
Middle Epipaleolithic	
Geometric Kebaran	Abri Bergy Levels I-III
	Azariq II. XVI, XVIII
	Azraq 8, 17, 22
	Ein Gev III
	El Khiam Level 9
	Fazael IIIC, VIII
	Haon II, III
	Hayonin Terrace Levels 8–9/D
	Kefar Daroum 28
	Kefar Vitkin II
	Kharaneh IV Levels C-D
	Kiryat Aryeh I
	Lagama North VIII (Rosh Horesha)
	Mushabi XIV (Level 2), XVI, XVII. XVIII. XXI
	Nahal Lavan 105
	Nahal Rut XVII
	Nahal Zin (D5)
	Neveh David
	Qadesh Barnea 8, Levels D, E, G
	Shunera I, III
	Soreq 33, 33MI
	Umm el Tlel2/III
	Wadi Ahmar II
	Yabrud Rockshelter III, Level 3
Middle/Late/ Final Hamran	El Quweira (J203)
	Jebel Hamra (J201) Levels A-C
	Jebel Muesei (J504) surface
	Qa Salab (J202) Levels A-C
	Henry's Sites J26, J31

(*continued*)

Table 6.11 (*continued*)

Assemblage-Group by Period	Representative Assemblages
Mushabian	Azariq X, XII, XX
	Lagama North XII
	Mushabi V, XIV (Level 1) XIX
	Nahal Nizzana XIV
	Ramad Matred II
	Shulhat Qeren II
Madamaghan	Jebel Fatma (J436)
	Tor Hamar (J431) Levels A-D
	Wadi Jilat
	Wadi Madamagh
Early & Middle Ramonian	Arif e-Naqa
	Azariq XIX
	Halutza 5B, 83, 89
	Hamifgash VIII
	Har Harif II, K6, K7, K8, K9, G9/GIX, KV
	Mitzpe Shunera I, II, V
	Mushabi I
	Nahal Boqer 3
	Nahal Lavan 1003, 1009/107, 106
	Nahal Neqarot
	Nahal Nizzana VIII, XII
	Nahal Sekher 81/M2+4
	Shunera XXI
Late Epipaleolithic	
Natufian	'Ain el-Saratan/Azraq 18
	Abu Hureyra 1
	Abu-al Husein
	Ain Chaub
	Ain Saratan
	Ala Safat
	Anteilas Cave
	Ayn Rahub
	Azariq XV, XXA
	Bawwab al-Ghazah
	Beidha
	Borj Barajne
	El Wad Cave Level B
	Eynan/Mallaha
	Givat Hayil I (LN)

Assemblage-Group by Period	Representative Assemblages
	Halutza 7, 82, 83, 84, 87, 89
	Hatoula
	Hayonim Cave Level B & Terrace
	Ira 10, 22
	Jebel es-Subhi
	Jebel Saaide/Saaide II Level C
	Jiita II East, III
	Kebara Cave Level B
	Khallat 'Anaza
	Lahav Area Sites (Point 508, Lehavim 2, Sansana 1, Beer Faher)
	Mugharet el-Jawa
	Mushabi XII
	Nachcharini Cave
	Nahal Beersheva I
	Nahal Haroa 17, 5
	Nahal Oren V–VI
	Nahal Rut VI
	Nahal Sekher 28
	Nahal Sekher VI)
	Qalat Anaza
	Rakefet Cave
	Rosh Horesha (LN)
	Rosh Zin
	Rumilah I
	Sabra I
	Saflulim
	Salibiya I
	Salibiya XII
	Shukhbah Cave Level B
	Shunera VII, XIII, XIV, XVIII
	Sunkh I
	Tabaqa/Wadi Hasa Site 1021
	Taibe Ain Rahub
	Tugra I
	Tulmeh
	Upper Besor 4, 6
	Wadi Hammeh Site 27
	Wadi Hasa (WHS) 1021, 1065
	Wadi Hisban 6

(*continued*)

Table 6.11 (*continued*)

Assemblage-Group by Period	Representative Assemblages
	Wadi Humeima (J406a)
	Wadi Judayid
	Wadi Qalkha
	Wadi Sliasl
	Wati Mataha
	Yaar Gevulot (LN)
	Yutil el-Hasa Level D
Late/Terminal Ramonian	Azariq III
	Ein Qadis II, VI
	Halutza 87,12
	Hamifgash VII
	Har Harif K2, K4, K5, K6, G13, G14
	Har Lavan II
	Lagama IX
	Lagama North VII, XI
	Mushabi II, IV, XXA
	Nahal Lavan IV
	Nahal Nizzana II
	Nahal Rut IV
	Nahal Sekher 23, 81/M1
	Shluhat Qeren I
	Shunera VII
	Upper Besor 5, 12
Harifian	Abu Salem
	Ramat Harif
	Shluhat Harif
	Romam
	Shluhat Romam
	Maaleh Ramon West, East
	Har Arod
	Ira 25
	Mushabi III, XV, XX
	Lagama IV
	Nahal Lavan 108,110
	Shunera VI, IX, X, X North, XXIV
	Upper Besor 6

Table 6.12. *Occurrence of Retouched Tool Types Commonly used to Differentiate Levantine Epipaleolithic Assemblages*

Epipaleolithic Assemblage Group	Microburin Technique	Obliquely Truncated & Backed Bladelets	Straight-Backed Bladelets	Arched & Curved Backed Bladelets	Micropoints, Micro-gravettes	Geometric Microliths	Lunates with Helwan Retouch
Nebekian	+		+		+		
Kebaran		+	+	+	+		
Nizzanan	+		+		+	Triangles	
Qalkhan	+		+		+	Triangles	
Early Hamran		+	+				
Geometric Kebaran			+			Rectangles Trapezoids	
Middle/Late/Final Hamran	+ (Late, Final)		+			Rectangles	+ (Final)
Mushabian	+			+	+	Triangles	
Madamaghan	+		+	+	+	rare	+
Early & Middle Ramonian	+	+					
Natufian	+					+	+
Late/Terminal Ramonian	+	+			+		+
Harifian	+						

Upper Paleolithic and by others as Early Epipaleolithic are discussed in Chapter 5). Figure 6.13 shows examples of Early Epipaleolithic artifacts.

Kebaran

Kebaran assemblages were first identified by Garrod on the basis of her analysis of collections from Kebara Cave Level C (Turville-Petre 1932). Most date to between 21.2 and 17.5 Ka cal. BP. The most distinctive characteristics of Kebaran assemblages are curved micropoints and backed and obliquely truncated bladelets (Kebara points, Jiita points). Truly "geometric" microliths are rare. Narrow-fronted blade cores are common and carinated pieces occur in variable frequencies. Kebaran assemblages are found mainly in the "core area" of the Mediterranean woodland, the coastal lowlands of the southern Levant, and both coast and interior highlands of the northern Levant between 24 and 18 Ka cal. BP.

Kebaran assemblages exhibit complex geographic and chronological patterning (Bar-Yosef 1970, Bar-Yosef and Vogel 1987, Goring-Morris 1995b, Hours 1974). Most of these differences revolve around non-geometric backed pieces. Among sites on the Coastal Plain of Israel, there is a tendency toward shorter micropoints. Falita points and microgravettes are common in eastern parts of the Levant (Syria, Jordan). Inverse retouch is common in Lebanon and northern Israel. There also appears to be a trend from predominantly shorter and curved-backed forms in Early Kebaran assemblages to either augmentation with or substitution by longer straight-backed and obliquely truncated forms in Later Kebaran assemblages (Bar-Yosef and Vogel 1987).

Nebekian

Nebekian assemblages were first identified by Rust (1950) at Yabrud Shelter III in Levels 6–7, but the term was largely subsumed into the Kebaran, as an early phase of that industry, until it was revived in the 1990s. Nebekian assemblages date to 24.0–21.8 Ka cal. BP. The most distinctive Nebekian artifacts are narrow, symmetrically curved, arch-backed pieces with oblique truncations. Bladelets from Nebekian assemblages feature more intensive (i.e., invasive) backing and frequent use of microburin technique for truncation. In fact, Nebekian

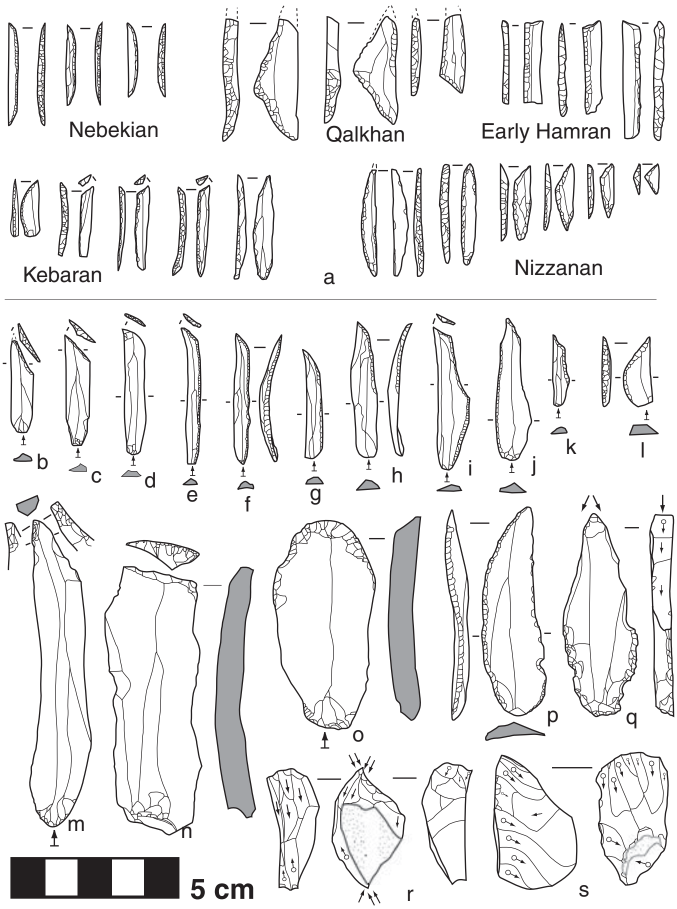


FIGURE 6.13. Early Epipaleolithic artifacts. a. microliths characteristic of various named industries, b–l. backed and/or truncated bladelets, m. perforator, n. truncated blade, o. endscraper, p. backed knife, q. dihedral burin, r. multiple burin/carinated piece, s. core. Sources for geometric microliths: Nebekian, Kebaran, Nizzanan microliths redrawn after Belfer-Cohen and Goring-Morris (2002), and Goring-Morris (1995b). Early Hamran, and Qalkhan microliths redrawn after Henry (1995c). Sources for other artifacts: Ein Gev I, Level 4 (b–k, m), Nahal Oren Pit G2–G3 (l, p, r), Ein Gev III (n–o), Jaita II (s), all redrawn after Bar-Yosef (1970).

assemblages mark the earliest use of the microburin technique in the Levant. Nebekian assemblages are found mainly east of the Jordan Valley. The occurrence of microgravettes in Nebekian assemblages from Tor Hamar may link Nebekian assemblages to the Nizzanan assemblages that follow them chronologically in Jordan.

Qalkhan

Henry (1995a) identified Qalkhan assemblages at Tor Hamar and other sites in the Wadi Qalkha, in southern Jordan. The most distinctive artifact of Qalkhan assemblages is the "Qalkhan point," a steeply backed scalene triangle with a concave basal truncation. This basal truncation is retouched, but it appears to have been created by the use of the microburin technique. The distribution of Qalkhan assemblages at numerous sites in southern Jordan and at Yabrud III and El Kowm in Syria suggests a link between this assemblage-group and activities in steppe-desert habitats.

Olszewski (2006) has recently argued that Qalkhan and Madamaghan (see discussion later in this chapter) assemblages are not, in fact, distinct from one another and that both sets of assemblages should be combined into the Nebekian.

Nizzanan

Nizzanan assemblages date to between 20.2 and 18.9 Ka cal. BP and are known mainly from sites in the southern Levant. The name is derived from the Nizzana Valley, in southern Israel. The technological dimension of Nizzanan assemblages is strongly laminar, with many conical (i.e., broad-fronted) single-platform blade cores and occasional opposed-platform blade cores. Scrapers and burins are common, particularly dihedral burins. Use of the microburin technique sets Nizzanan assemblages apart from Kebaran assemblages and aligns it more with Qalkhan, Early Hamran, and Mushabian assemblages. The production of scalene bladelets is a further possible link to Mushabian assemblages. The most distinctive typological characteristics of Nizzanan assemblages are minute triangles (mainly scalene and isosceles variants) and microgravettes produced with the microburin technique. Most Nizzanan occurrences are located east of the Jordan Valley or in the Negev, and the southern Israeli Coastal Plain. Nevertheless, there are a few occurrences of distinctively Nizzanan triangles from the northern Israeli Coastal Plain and Lebanon.

Early Hamran

In southern Jordan, Henry (1995a: 39) has identified an Early Hamran group of assemblages dating to more than 15 Ka cal. BP. The name is derived from Jebel Hamra in Jordan. Early Hamran assemblages are distinguished by broad steeply backed blades truncated by snaps, rather than retouch. Although characteristically Kebaran narrow micropoints are absent or rare, Henry views the Early Hamran as most closely analogous to the later phases of the Kebaran. As of this writing, the Early Hamran appears to be a local, or at best, south Jordanian phenomenon.

Middle Epipaleolithic (18–15 Ka cal. BP)

Middle Epipaleolithic assemblage-groups include the Geometric Kebaran, Middle-Late Hamran, Mushabian, Madamaghan, and Ramonian. Figure 6.14 shows examples of Middle Epipaleolithic artifacts.

Geometric Kebaran

Geometric Kebaran assemblages were first identified by Bar-Yosef (1981) at a wide range of sites in Israel. Most Geometric Kebaran assemblages date to 18.0–16.3 Ka cal. BP. These assemblages share with their Kebaran predecessors blade/bladelet production and obliquely truncated and backed bladelets. These are augmented by geometric microliths produced without the use of the microburin technique. The distinctive typological characteristics of Geometric Kebaran assemblages are: (1) backed and truncated pieces in a wide range of rectangular and trapezoidal shapes, and (2) elongated endscrapers. There appears to be a chronological trend toward wider blades and thus broader geometric microliths (Bar-Yosef and Belfer-Cohen 1989: 463). Geometric Kebaran assemblages are found across nearly the entire Levant, from the Euphrates Valley to the Sinai Peninsula and from the Mediterranean coast to the Transjordan plateau. Geometric Kebaran assemblages from the likely "core area" of human settlement seem to show greater variation in geometric microlith types. Assemblages from the Negev exhibit less variation and a dominance of trapezes and rectangles among microlithic tools.

Middle-Late/Final Hamran

Middle Hamran assemblages are similar to the Geometric Kebaran in featuring rectangles and trapezes among geometric microliths and usually lacking evidence for the use of the microburin technique. They differ from Geometric Kebaran assemblages mainly in having narrower backed microliths. Late Hamran assemblages contain shorter blades and show evidence of the use of the microburin technique. In Final Hamran assemblages, geometric microliths are replaced by lunates, evidence of the use of the microburin technique, and backing by bifacial "Helwan" retouch.

Mushabian

Mushabian assemblages were first identified by research in the Sinai, and later expanded on by research in Negev (Bar-Yosef and Phillips 1977, Goring-Morris 1987). The name is derived from sites near Wadi Mushabi in the Sinai. The Negev and Sinai appear to be the core areas of Mushabian occurrences, and in these regions they are contemporaneous with Geometric Kebaran assemblages (17.0–15.5 Ka cal. BP). The signature lithic attributes of Mushabian assemblages are arch-backed bladelets and scalene triangles produced using the microburin technique. Smaller numbers of expanding or "splayed" backed bladelets and symmetrical/asymmetrical trapezes occur as well. Later Mushabian assemblages contain lunates with Helwan retouch. Small numbers of groundstone tools occur in Mushabian assemblages. Most notable among the latter are shallow, minimally modified bowls stained with red ochre. Shells found with Mushabian sites suggest exchanges with groups living in the Red Sea Basin and possibly the Nile Valley as well.

Madamaghan

Madamaghan assemblages are known mainly from sites in southern Jordan (Henry 1995a: 40). Their main characteristics are arch-backed bladelets, La Mouillah points, microgravettes, and low percentages of geometric backed forms. Blades are relatively long and wide, and the use of the microburin technique is common. The name, Madamaghan, is derived from Madamagh a rockshelter near Petra in Jordan (Kirkbride 1958).

Ramonian

Ramonian assemblages are found exclusively in the Negev/Sinai and mainly in contexts dating to the very end of the Middle Epipaleolithic, 16.8–14.4 Ka cal. BP. (In older literature, Ramonian assemblages are described as "Late Mushabian" or "Negev Kebaran.")

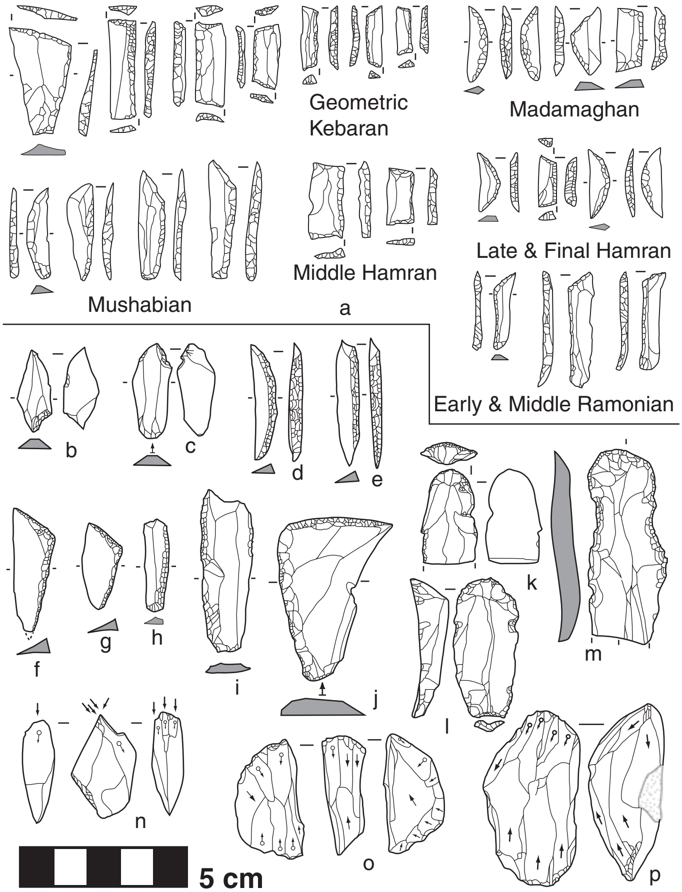


FIGURE 6.14. Middle Epipaleolithic artifacts. a. Geometric microliths characteristic of various named industries, b. distal microburin, c. proximal microburin, d–e. backed blade with microburin truncation (La Mouillah points), f–g. triangles, h–i. backed bladelets, j. arch-backed and truncated flake, k. distal fragment of endscraper, l. endscraper-truncation, m. strangulated endscraper, n. multiple burin/microblade core, o–p. cores. Sources for microliths: Geometric Kebaran, Early and Middle Ramonian, Mushabian after Belfer-Cohen and Goring-Morris (2002), and Goring-Morris (1995b). Madamaghan, Middle, Late and Final Hamran after Henry (1995c). Sources for other artifacts: Musahabi XIV, Level 1 (b–e, h–i, m), Lagama North VIII (f–g, j), Poleg 18M (o–p), Poleg 18MII (n), SMU D5 (k–l). Redrawn after Bar-Yosef (1970), Bar-Yosef and Phillips (1977), Marks (1976d).

Ramonian assemblages are divisible into Early Ramonian and Late Ramonian Phases, as well as a Final Ramonian phase discussed later (Goring-Morris 1995b). The main technological characteristics of Ramonian assemblages include a marked preference for chalcedony as a worked material (some of which may have been thermally altered), wide-fronted single-platform blade cores, and relatively narrow blades/bladelets. Single-platform cores predominate, but are accompanied by smaller proportions of other core types. Ramonian assemblages' most distinctive typological features are Ramon points – concave-backed, obliquely truncated bladelets produced using the microburin technique. These points dominate the retouched tool component of all systematically collected assemblages. The larger retouched tool component features large end- and side-scrapers with invasive retouch. The name, Ramonian, is derived from the Maktesh Ramon erosional basin in the Negev.

Late Epipaleolithic (15–12 Ka cal. BP)

Late Epipaleolithic assemblage-groups include the Natufian, Terminal Ramonian, and Harifian. There are fewer named assemblage-groups in this period than in either the Early or Middle Epipaleolithic. It is possible this reflects social processes, such as increased cultural contacts among Levantine groups resulting in a kind of cultural homogenization. On the other hand, it is also possible that, because the Natufian assemblage-group was identified early in the course of prehistoric research in the region, Levantine prehistorians have tended to attribute Later Epipaleolithic assemblages to the Natufian because it is a well-known archaeological entity. Figure 6.15 shows examples of Late Epipaleolithic stone tools.

Natufian

Natufian assemblages were first identified by Garrod (1932) on the basis of her findings at the caves of Shukhbah (in the Wadi en-Natuf), Kebara, and el-Wad. Natufian core technology includes both blade/bladelet and flake production, but with greater numbers of multiplatform, discoidal, polyhedral, and other "informal" cores. Many of the latter cores are very small (<20 mm long), attesting to intensive core reduction. Lunates/crescents are the most distinctive typological feature of Natufian assemblages. These lunates are often backed with

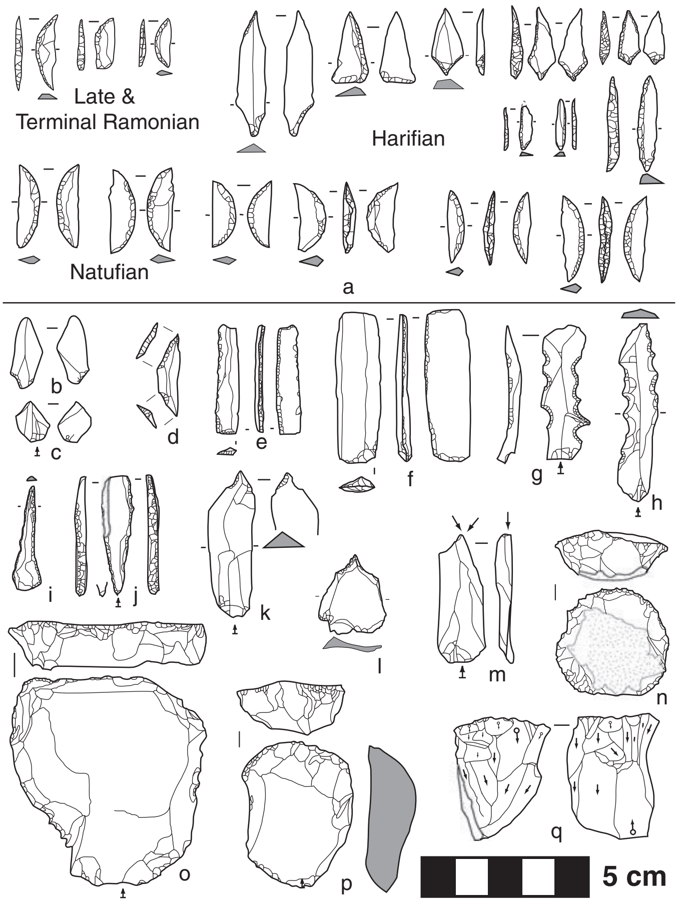


FIGURE 6.15. Late Epipaleolithic artifacts. a. Geometric microliths and points characteristic of Late and Terminal Ramonian, Harifian, and Natufian industries, b. distal microburin, c. proximal microburin, d. trapeze, truncated, and backed bladelets/sickle inserts, g–h. multiple notches on blades, i. borer, j. double-backed blade/borer, k–l. perforators, m. dihedral burin, n. scraper on cortical flake, o. massive scraper, p. endscraper, q. bladelet core. Sources for microliths: Late and Terminal Ramonian Belfer-Cohen and Goring-Morris (2002), Harifian (N. Goring-Morris 1991; Scott 1977). Natufian: Goring-Morris (1995b), Byrd and College (1991). Sources for other artifacts: Tabaqat Fahl (b–d, h, k, q), Beidha (e–g), Rosh Zin (j, o), Saaïdé II (l, n, p), Rosh Horesha (m), unspecified Harifian site (i). Redrawn after Belfer-Cohen and Goring-Morris (2002), Byrd (1991), Byrd and College (1991), Goring-Morris (1991; 1995b), Henry (1976), Marks and Larson (1977), Schroeder (1991), Scott (1977).

bifacial ("Helwan") retouch, and they are sometimes produced with the use of the microburin technique. Over time, there appears to be a trend toward the production of shorter and narrower lunates. Geometric microliths, such as rectangles, trapezes, and triangles, occur in Natufian assemblages, but they are more common in later Natufian assemblages than in earlier ones. Burins and sickle inserts are common in the lowlands and central Levant (northern Israel) but rare in the Negev, Sinai, and Transjordan. Other components, such as denticulates and notches, vary without clear patterning. Borers and awls are common in all Natufian assemblages. Their abundance marks a break with preceding Epipaleolithic assemblages, and it may be related to the production of shell and bone beads, which are commonly found in Natufian contexts. Picks occur in some assemblages, albeit usually in low frequencies. Natufian sites, particularly those in the coastal lowlands, feature rich inventories of groundstone tools, including concavities carved into bedrock (bedrock installations) at some sites.

If one identifies all Later Epipaleolithic assemblages with lunates as Natufian (a common practice in Levantine prehistory), then this assemblage-group spans very nearly the entirety of the East Mediterranean, from the Taurus Mountains to the Sinai Peninsula. Most researchers, however, subdivide the Natufian chronologically into an Early Natufian (14.9–13.7 Ka cal. BP), which is more extensively distributed, and Late/Final Natufian (13.5–11.7 Ka cal. BP), which is more restricted in its geographic distribution.

Natufian lithic assemblages are also associated with rich bone and shell assemblages. Many of these bones and shells were shaped by carving and/or drilling and polishing with stone tools. This florescence of art and symbolic evidence marks a major break with the preceding Early and Middle Epipaleolithic, and indeed with the Levantine Upper Paleolithic, too.

Late/Terminal Ramonian

Late/Terminal Ramonian assemblages are found mainly in the Negev/Sinai in contexts dating to 14.9–13.7 Ka cal. BP (Goring-Morris 1987, 1995b). They differ from Early and Middle Ramonian assemblages by featuring Helwan retouch and lunates. These latter qualities are thought to reflect cultural contacts with the makers of Natufian assemblages. As in earlier Ramonian assemblages, chalcedony is a preferred raw material for microlith production. The systematic production of Ramon points is further evidence of continuity with Early/Middle Ramonian knapping traditions. Ramon points from Late/Terminal Ramonian contexts are somewhat larger than those from Early/Middle Ramonian contexts.

Harifian

Harifian assemblages take their name from the Har Harif (Harif Mountain) in the Sinai in contexts dating to 12.5–11.8 Ka cal. BP (Goring-Morris 1991). The most typologically diagnostic component of Harifian assemblages is the Harif point, a point formed by a long oblique distal truncation, a backed lateral edge, and convergent oblique truncations at its base. Lunates and other backed pieces are known as well, as are a wide range of groundstone tools thought to reflect seed processing. Single-platform cores predominate. The microburin technique was used to shaped crescents. It was also used to shape the tip, but not the base, of Harif points. There appears to be a preference for the use of chalcedony for microlithic tools at Abu Salem and some of the other higher elevation sites. It is not clear whether this was a cultural preference or simply a reflection of local raw material availability.

Partly because Harifian assemblages overlap with Early Neolithic assemblages between 11.6 and 11.0 Ka cal. BP, there is some division of opinion about whether it should be considered "Epipaleolithic" or "Neolithic." In this book, it is treated with Epipaleolithic assemblages mainly on the basis of its technological and typological qualities, which are more closely aligned with Epipaleolithic assemblages.

Epipaleolithic in the Montane Levant

The Epipaleolithic complexes of montane Southwest Asia have strong parallels with the Levantine record. The best documented of these montane Epipaleolithic assemblage-groups are "Zarzian" assemblage-groups, named after Zarzi Cave in Iran. Zarzian technology emphasizes bladelet production from pyramidal cores. Inverse retouch and denticulation are common on bladelets. The most distinctive typological components of Zarzian assemblages are microliths in the form of elongated triangles and trapezoids. Age estimates for Zarzian assemblages are not well-constrained, but most sources place Zarzian occurrences between 17 and 10 Ka cal. BP. Additional occurrences of Zarzian assemblages are known from Warwasi, Shanidar Cave and Palegawra (Olszewski 1993). Kozlowski and Aurenche (2005) identify an Epipaleolithic Trialétien Industry from Anatolia and the Caucasus. In its technological and typological characteristics (bladelet production and an emphasis on triangular and trapezoidal microliths) these assemblages seem superficially similar to Zarzian assemblages to the East and to Geometric Kebaran assemblages to the South.

V. OVERVIEW

Most of the key contrasts between the Epipaleolithic and Upper Paleolithic stone tool technologies are related to increased production of bladelets shaped into a variety of geometric microlithic forms. The microburin technique was used to truncate flakes to varying degrees. Groundstone tools begin to appear in significant numbers, as do bifacially flaked celts and heavy-duty core-tools. With respect to most other aspects of core technology and tool typology there are relatively few notable differences between Epipaleolithic and later Upper Paleolithic stone tool assemblages.

There are many general similarities between the Levantine Epipaleolithic and lithic assemblages of roughly equivalent age in Mediterranean North Africa and the Nile Valley (Garcea 2010, Schild and Wendorf 2010) as well as in montane western Asia (Düring 2011, Kozlowski 1999). Many of these similarities are simply reflections of a common microlithic technology (e.g., the use of the microburin technique). The specific conjunctions of technological and typological features of Levantine Epipaleolithic assemblages are not exactly replicated in other regions.

Improvements to the lithic record for the Epipaleolithic could include simplifying artifact typologies, reducing the number of named industries, and reuniting the Epipaleolithic Period with the Upper Paleolithic.

At the very least, some consideration should be given to reducing the number of named, distinct modes of retouch. The differences among these modes are so subtle and/or so subjectively evaluated as to raise questions about inter-observer consistency in their application to archaeological collections.

The same recommendations about retouch contingencies could apply equally well to the numerous named types of Epipaleolithic end-scrapers, burins, and backed/truncated pieces. Many of these typological distinctions were coined in early, exploratory phases of prehistoric research in western Europe, northern Africa, and western Asia. They persist in these regions not because they help archaeologists solve essential research problems, but because of scholarly inertia. One hesitates to make the same recommendation about Epipaleolithic points and geometric microlith typology. These artifacts carry heavy analytical weight in terms of assemblage-groupings; and they seem to be working well in this purpose. Nevertheless, it would inspire greater confidence in their use if typological assignments were based on measurements, rather than on visually assessed morphological analogy.

The number of named Levantine Epipaleolithic stone tool industries is also in desperate need of pruning (Olszewski 2006). There is clearly far more variation than can reasonably be accommodated by the older Kebaran, Geometric Kebaran, and Natufian triad, but there are also distinctions among Epipaleolithic assemblage-groups that seem to owe more to the presence of modern-day political boundaries than they do to plausible barriers to social interactions among mobile prehistoric hunter-gatherers. Many taxonomic differences among Epipaleolithic assemblage-groups revolve around relative frequency variation in artifact-types, a quality of variability almost certainly affected by sample size, which, in turn varies widely among Epipaleolithic assemblages. It would be interesting to see how relative frequency variation and morphometric variability among Epipaleolithic microlith pattern out in time and space and whether they reinforce or contradict traditional assemblage-group-level distinctions when adequate controls for sample size are put in place.

Lastly, one wonders whether it is worth retaining the distinction between the Upper Paleolithic and Epipaleolithic periods. The main differences between lithic assemblages from these periods boil down to little more than increased production of microlithic tools and, toward the end of the Epipaleolithic, increased use of groundstone tools. The underlying economic and ecological differences originally thought to justify a categorical distinction between these periods – a broader ecological niche and increased sedentism – no longer resolve themselves as dichotomies, but instead as complex continua of behavioral variability. In terms of the lithic record, the differences between Upper Paleolithic and Epipaleolithic assemblages appear trivial compared to those between both of these periods and either the Lower and Middle Paleolithic on the one hand, or the Neolithic, Chalcolithic, and Bronze ages on the other.

7

THE NEOLITHIC

I. INTRODUCTION

The term "Neolithic" was coined by Lubbock (1865) to recognize a shift in the European archaeological record from an earlier period during which stone tools were shaped exclusively by fracture (the Paleolithic) and a more recent period during which abrasive processes were also used (the Neolithic). Over the course of the early twentieth century, the definition of the Neolithic period was modified to designate the onset of agriculture, pastoralism, settled village life and complex social institutions (Bar-Yosef 2001, Cauvin 2000, Childe 1936, Kuijt 2002). In the Levant, the onset of the Neolithic Period begins in early Holocene times (11.7 Ka or 9700 BC) and its end is generally fixed at around the Mid-Holocene (7 Ka or 5800 BC) (Simmons 2007). Unlike in Europe, where the Neolithic was first identified and where it arrived as a coherent package, in the Levant, the behavioral innovations that mark the Neolithic (cereal agriculture, domesticated food animals, ceramics, and sedentary village life) occur in a stage-wise sequence. Additionally, in contrast with Europe, the Neolithic of the Levant was an autochthonous development rather than something brought to the region by human populations dispersing from elsewhere.

The paleoclimatic backdrop to the Neolithic Period in the Levant is complex, but in its simplest form encompasses a shift from colder and drier but widely variable Pleistocene conditions to a warmer and more humid Holocene climate after around 13 Ka (Burroughs 2005).

Richerson et al. (2001) have argued that it was the stability of Holocene climates compared to Pleistocene climates that enabled agriculture and pastoralism to work as adaptive strategies. The millennium-long "Younger Dryas" cold snap (12.8–11.5 Ka) was a short-lived reversal of this trend, one some have implicated in sedentism and in plant and animal domestication (Bar-Yosef 2011). Others, however, argue for much less of a role for climatic forcing in Neolithic origins (Belfer-Cohen and Goring-Morris 2011, Cauvin 2000, Goring-Morris and Belfer-Cohen 2011). For the first half of the Holocene, the Levant probably experienced increases in the extent of woodlands and steppe and the retreat of deserts in the south and up-altitude. Today's vegetation cover is but a fraction of what it was in early Holocene times, but it is difficult to disentangle anthropogenic factors (e.g., overgrazing) versus climatic influences on this pattern.

Neolithic Human Behavioral Evolution

In early syntheses of prehistory, Neolithic innovations such as agriculture, pastoralism, and village sedentism are often portrayed as across-the-board improvements in the human condition, as a "revolutionary" development in human bio-cultural evolution. This view remains popular; however, recent years have seen the emergence of perspectives that take into account some of the more deleterious consequences of Neolithic lifeways on individual health (dental and zoonotic diseases), demographic stability (overpopulation), and environmental quality (nutrient depletion and soil erosion) (Cohen 1977, Diamond 1987). Other contemporary views of the "Neolithization" see the process in cognitive and spiritual terms, as either the cause or the consequence of new ways of conceptualizing the natural world (Cauvin 2000, Hodder 2007). Sorting out and judging the merits of these perspectives (none of which are necessarily mutually exclusive) lies beyond the scope of a work focused on stone tools; but before discussing the Neolithic lithic record, one has to define what the Neolithic is (or was).

Defining the Neolithic

The "Neolithic" way of life involves at least two major shifts in human adaptive strategies: (1) controlling the reproduction of focal plant and animal species, and (2) reducing residential mobility. The immediate consequences of these shifts include increased population size and the depletion of previous subsistence staples (wild plants and animals). Longer term consequences involve population growth, increases in territorial defense, organized coalitionary conflict, and population dispersals (Bocquet-Appel 2011). Much of what we think we know about the Neolithic is based on observations of what happens in recent times when hunter-gatherers do these things. Most recent hunter-gatherers, however, live in habitats of marginal value to agriculturalists and pastoralists (Kelly 1995). The incentives for hunter-gatherers to adopt agriculture or pastoralism in these regions likely differ, and are probably lower, than those of terminal Pleistocene hunter-gatherers living in habitats that were nearly optimal for food production. Nevertheless, prehistoric hunter-gatherers' course to agriculture could have been a complex, on-again, off-again process (Zeder 2011). Most comparative studies of energy expenditure and labor organization between recent human hunter-gatherers and farmer-herders suggest the latter work harder per unit of energy recovered from their habitat (Lee 1979). To an extent, this view of "Neolithization" as a kind of intensification has parallels in the lithic evidence. Many Neolithic stone tools appear to have been subjected to greater amounts of modification than their Paleolithic counterparts, suggesting increased dependence on stone tools. Ironically, although stone tools play a relatively minor role in the culture-history and systematics of the Neolithic Levant, the lithic record itself suggests Neolithic humans may have been even more dependent on stone tools than their Paleolithic ancestors.

Why Was there a Neolithic?

Early twentieth century archaeological theories about the origins of the Neolithic way of life, or plant/animal domestication and sedentism, focused on deducing the specific geographic areas in which these phenomena occurred. Childe (1936) initially proposed these processes might have arisen among populations concentrated along the Nile valley and Mesopotamia by an arid episode at the end of the Pleistocene. Later speculation focused on the "hilly flanks" of Mesopotamia, where mixed woodlands and steppe were home to the wild counterparts of Southwest Asia's principal domesticated plants and animals (Braidwood 1960). Mid-century theories focused less on specific geographic locations than on the variable incentives for domestication in the core and periphery of hunter-gatherer habitats (Binford 1968, Flannery 1973). More recent hypotheses about Neolithic origins have focused on the role of population pressure, the desire for socially useful food surpluses, and even cognitive shifts in human populations (Bender 1978, Cauvin 2000). The relative significance of these factors is hotly debated among experts on the Neolithic period (Price and Bar-Yosef 2011). The bottom line, as it were, is that even though we use different terms for the Paleolithic and Neolithic, the division between these periods is more apparent than real. Agriculture, pastoralism, and sedentary village life arose from selective pressures on the adaptive strategies of residentially mobile hunter-gatherers. Absent any strong evidence for an interruption of human occupation in the Levant, the origins of the Neolithic there are best understood as a process rather than an event.

The Neolithic Archaeological Record

The archaeological record for the Neolithic Period in the Levant is a rich one. It has been the focus of concerted archaeological research for nearly a century, and by excavations at dozens of Neolithic sites. Some of the most important of these sites (out of a vastly larger number) are listed in Table 7.1 and plotted on a map in Figure 7.1. Early investigations of Neolithic sites followed from excavations of deeply stratified sites. The amount of Neolithic occupations that could be exposed by these excavations was severely limited, and, consequently, much of the earlier literature on the Neolithic focused on stratigraphic concerns. The excavations at Jericho (Kenyon and Holland 1983) and Byblos (Cauvin 1968), at which stratified Neolithic occupations are not deeply buried under more recent deposits, marked major turning points in terms of archaeologists' ability to perceive variability in Neolithic material culture. Excavations at Jarmo (Braidwood et al. 1974) focused on the recovery of plant and other biotic remains also led to more explicitly ecological investigations of the Neolithic from about the middle of the twentieth century onward. More recent investigations, such as those at Ain Ghazal, Shaar Hagolan, Kfar Hahoresh, Göbekli Tepe, and other sites further afield, such as Çatalhöyök, have increasingly focused on the social, symbolic, and ritual aspects of Neolithic life.

Table 7.1. *Major Neolithic Sites and Sub-Periods Represented at them*

Site Name	Early Neolithic	Middle Neolithic	Late Neolithic	Reference
NORTHERN LEVANT				
Qaramel	+			Mazurowski et al. (2009)
Nachcharini Cave	+			Garrard et al. (2003)
Çayönü	+	+		Braidwood et al. (1974)
Hallan Çemi Tepesi	+	+		Rosenberg and Redding (2002)
Nemrik	+	+		Kozlowski (1989)
Qermez Dere	+	+		Watkins et al. (1989)
Jerf el Ahmar	+	+		Stordeur and Abbès (2002)
Sheikh Hassan	+	+		Boese (1995)
Mureybit	+	+		Ibàñez (2008)
Abu Hureyra 2	+	+		Moore et al. (2000)
Tel Aswad	+	+		Cauvin (1974b)
Gobeckli Tepe	+	+		Schmidt (2000)
Gritille		+		Ellis and Voigt (1981)
Nevali Çori		+		Schmidt (1994)
Dja'de		+		Coqueugniot (2000)
Halula		+		Molist and Borrell (2007)
Tel Ghoraifé C		+		Cauvin (1975)
Tel Ramad		+		De Contenson (2000)
Bouqras		+	+	Roodenberg (1986)
Ras Shamra		+	+	Coceuegniot (1991)
Byblos		+	+	Cauvin (1968)
Tel Sabi Abyad		+	+	Verhoeven and Akkermans (2000)
El Kowm		+	+	Stordeur (1989)
Labwe			+	Kirkbride (1969)
SOUTHERN LEVANT				
Gesher	+			Garfinkel and Dag (2006)
Iraq ed-Dubb	+			Kuijt and Goodale (2006)
Salibiya IX	+			Enoch-Shiloh and Bar-Yosef (1997)
Netiv Hagdud	+			Bar-Yosef and Gopher (1997)
Gilgal I	+			Bar-Yosef et al. (2010)
Hatoula	+			Lechevallier et al. (1989)
El Khiam	+			Echegaray (1964)
Zahrat adh-Dhra' 2	+			Edwards et al. (2004)

(*continued*)

Table 7.1 (*continued*)

Site Name	Early Neolithic	Middle Neolithic	Late Neolithic	Reference
Wadi Feinan 16	+			Levy et al. (2001)
Beisamoun		+		Groman-Yaruslavski and Rosenberg (2010)
Nahal Oren	+	+		Noy et al. (1973)
Jericho	+	+	+	Kenyon and Holland (1983)
Dhra'	+		+	Kuijt and Mahasneh (1998)
Yiftahel		+		Garfinkel (2002)
Atlit Yam		+		Galili et al. (1993)
Kfar Hahoresh		+		Goring-Morris (2008)
Abu Suwwan		+		Al-Nahar (2010)
Abu Ghosh		+		Khalayla and Marder (2003)
Tel Tifdan (Wadi Fidan 1)		+		Levy et al. (2001)
Nahal Hemar Cave		+		Bar-Yosef and Alon (1988)
Ghwair		+		Simmons and Najjar (2006)
Beidha		+		Mortensen (1970)
Basta		+		Gebel et al. (1998)
'Ain Abu Nekheileh		+		Henry (2003)
Nahal Issaron		+		Gopher et al. (1994)
Abu Maadi I		+		Bar-Yosef and Phillips (1977)
Munhata		+	+	Gopher (1989)
Wadi Shu'eib		+	+	Simmons and Najjar (2006)
'Ain Ghazal		+	+	Rollefson et al. (1992)
Megiddo			+	Loud (1948)
Sha'ar Hagolan			+	Alperson and Garfinkel (2002)
'Ain Rahub			+	Muheisen et al. (1988)
Jebel Abu Thawwab			+	Kafafi (2001)
Wadi Rabah			+	Kaplan (1958)
Teluliot Batashi			+	Kaplan (1959)
Ashkelon			+	Garfinkel and Dag (2008)
Qatif Y-3			+	Yeivin and Olami (1979)

Notes: For the purposes of this table, the North Levant and the Southern Levant are divided at approximately 33° N Latitude. Attributions to Early, Middle, and Late Neolithic Periods largely follow Simmons (2007), as follows: PPNA = Early Neolithic, PPNB = Middle Neolithic, Pottery Neolithic = Late Neolithic.

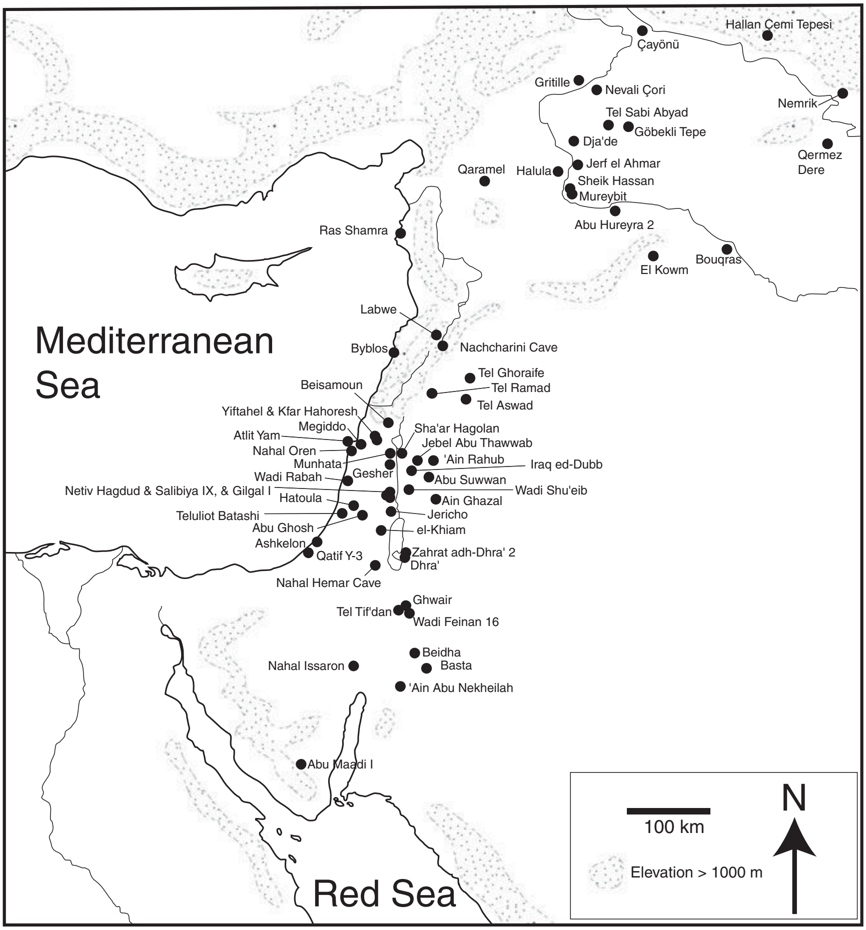


FIGURE 7.1. Map showing important Neolithic sites.

The chronostratigraphy of the Neolithic is complicated by the use of two different frameworks in the southern and northern Levant. Both subdivide the Neolithic on the basis of changes in stone tools, architecture, and ceramics. The *Atlas des sites du Proche Orient* (ASPRO) framework (Hours et al. 1994), used mainly by a small number of researchers in the northern Levant, is less popular and not discussed further. The Neolithic framework for the southern Levant divides the period into Pre-Pottery Neolithic (PPN) and Pottery Neolithic (PN) periods, which are each in turn further subdivided (PPNA, PPNB, PPNC; and PNA, PNB, respectively). For the sake of simplicity, this

Table 7.2. *Chronostratigraphy for the Neolithic Period*

Periodization used here	Southern Levant Neolithic Phases	ASPRO Phases	Dates bp (uncal-ibrated ^{14}C)	Dates BP (cali-brated ^{14}C)	Dates BC
Early Neolithic (12.2–11.0 Ka cal. BP)	Pre-Pottery Neolithic A(PPNA)	2	10,200–9400	12,175–11,000	9700–8500
Middle Neolithic (11.0–8.4 Ka cal. BP)	Pre-Pottery Neolithic B(PPNB/C)	3–4	9500–7500	10,950–8400	8500–6250
Late Neolithic (8.4–6.5 Ka cal. BP)	Pottery Neolithic (PN)	5–6	7500–6000	8400–6500	6250–5300

Note: Dates follow Twiss (2007) and Goring-Morris and Belfer-Cohen (2011).

chapter uses a simple tripartite scheme whose concordance with the ASPRO and southern Levantine frameworks are presented in Table 7.2.

The Early Neolithic Period (12.2–11.0 Ka cal. BP) witnessed a shift of settlement toward alluvial fans and other areas favorable to cereal cultivation. This being said, caves/rockshelters continued to be used and actual evidence for cereal agriculture is sparse. Early Neolithic humans were still hunter-gatherers, albeit ones living in larger, more stable residential sites and ones supplementing wild plant foods with some cultivated cereal grasses. House foundations are round or oval, and their sizes are somewhat larger in Early Neolithic than in Natufian contexts. This, and seemingly greater attention to stone foundations is thought to reflect population growth. In terms of the lithic record, the main emergent features of the Early Neolithic are decreasing production of geometric microliths, increased production of flaked and groundstone celts/axes, and the systematic manufacture of relatively short, tip-mounted projectile armatures. Art and symbolic evidence from Early Neolithic contexts are variable within the larger Levant, suggesting a culturally heterogeneous population. Toward the end of the Early Neolithic, human settlement extended from the Levant to Cyprus.

The Middle Neolithic Period (11.0–8.4 Ka cal. BP) saw substantial increases in the maximum extent of habitation sites. Houses and other structures are larger, rectangular in plan view, and often feature stone foundation-walls and plastered floors. Paleobotanical remains point unequivocally toward cereal cultivation, and zooarchaeological assemblages provide evidence of sheep and goat domestication. The signature lithic artifacts of this period are projectile points, sickle inserts, and other flaked stone tools made on long, narrow blades struck form bipolar cores. Toward the end of this period, ca. 8.6–8.3 Ka cal. BP, ceramic vessels made out of marl and clay occur in some sites. Broad similarities in architecture, lithic technology, and symbolic evidence suggest the Middle Neolithic cultural landscape of the Levant was more homogeneous than in earlier periods. Obsidian artifact distributions across the region and typological similarities across multiple classes of evidence suggest larger communities networked to one another across much of the region, even though there were likely significant economic divisions among them. That is, these networks probably encompassed groups subsisting from agriculture, pastoralism, and hunting and gathering in various combinations.

The Late Neolithic Period (8.4–6.5 Ka cal. BP) is distinguished by the appearance of ceramic vessels made mainly of clay, instead of marl and of small, extensively retouched projectile points. In other respects, however, the Late Neolithic marks a parting of the ways between the northern and southern Levant. In the south, many larger Middle Neolithic sites appear either to have been abandoned or to have experienced marked reductions in population size. Architecture becomes more variable, and at larger sites often involves extensive stone constructions, such as paved areas, streets/alleys, and storage facilities. In the northern Levant, site sizes do not decrease, but seem either to hold steady or to increase, particularly at sites near larger rivers. Evidence for cattle and pig domestication appears during this period and evidence for hunted wild game decreases. Marked differences in the size and contents of residential structures suggest growing economic inequalities among Late Neolithic societies. Variability in ceramic wares between the southern and northern Levant, and particularly within the northern Levant, suggests a kind of cultural fragmentation and/or reconsolidation. Rare finds of copper artifacts hint at metal pyrotechnology. Ceramic and other architectural continuities link many of these Late Neolithic assemblage-groups (which are almost universally described as "cultures") to subsequent Chalcolithic and Early Bronze Age entities.

Neolithic Lithics References

Oddly, considering the volume of the lithic evidence from the Neolithic Period, the Levant lacks any kind of standardized typology such as those deployed in the study of earlier time periods (see Chapters 3–6). There are some broadly agreed-upon conventions for describing particular artifact-types, but there is also substantial variability in the ways the lithic evidence is described by archaeologists in different countries, and by those working in different research traditions, even among descriptions of lithic assemblages by the same author. Although frustrating from the perspective of one attempting a synthesis of this evidence, this situation is a predictable consequence of there being substantially more Neolithic evidence than Paleolithic evidence and many more Neolithic archaeologists than Paleolithic ones. Recognizing the growing problem of terminological anarchy, the *ex oriente* research group has met in Berlin since the early 1990s to systematize Neolithic lithic terminology (Rollefson 1994). Their focus has been mainly on the Early and Middle Neolithic, but their innovations have been adopted in descriptions of Late Neolithic assemblages as well. Many of their recommendations have been disseminated on the Internet (www.exoriente.org) and are incorporated in this chapter.

II. NEOLITHIC TECHNOLOGY

Neolithic stone technology is marked only by subtle breaks with its Epipaleolithic predecessors. Most of the techniques and methods used for knapping stone during Epipaleolithic times continued into the Neolithic. Nevertheless, there are important shifts in core technology and in the resulting flakes. Obsidian, formerly exploited mainly in the northernmost Levant and Anatolia, where it occurs naturally, is increasingly found among Neolithic assemblages from the central and southern Levant. The most significant derived feature of Neolithic stone tool technology, however, involves groundstone tools, artifacts shaped by percussion and abrasion.

Table 7.3. *Neolithic Core Types*

Major Core Types	Minor Core Types.
Flake Cores	Single platform unidirectional flake core
	Single platform discoidal flake core/discoid
	Parallel-opposed double platform flake core
	Perpendicular-opposed double platform flake core
	Multiple-platform flake core
	Pebble core
	Elongated flake core ("roughout")
	Other/Irregular flake core
Unidirectional blade cores	Unidirectional -pyramidal or sub-pyramidal blade core
	Bullet-shaped blade core
Bidirectional blade cores	Bipolar bidirectional blade core
	Postero-lateral bidirectional blade core
	Naviform bidirectional blade core
	Other blade core
Other Cores	Tested nodules

Core Technology

Neolithic core technology has three main components: flake-cores, prismatic blade core technology, and a residual of other core types (Table 7.3). Neolithic core technology emphasizes systematic blade and bladelet production to a greater extent than in later Epipaleolithic contexts. Arguably, this could reflect a degree of craft specialization in flintknapping.

Neolithic Flake Cores

As a group, Neolithic flake cores are defined in contrast to Neolithic blade cores. That is, they lack flake scar patterning referable to prismatic blade production (Figure 7.2.a, g–i). In principle, Neolithic researchers subdivide flake cores in terms of their number of striking platform surfaces and the alignment of striking platform surfaces in relation to one another (Rollefson 1994). Seven main kinds of Neolithic flake cores occur in the literature, although many studies recognize either more or less than these seven. Single platform unidirectional flake cores are usually hemispherical in shape with flakes detached in one direction only. They may be either broad- or narrow-fronted. Single-platform discoidal flake cores are alternate cores, with a single striking platform that makes a circuit around the core. Parallel-opposed double platform flake cores have two striking platforms aligned roughly parallel to one another. Perpendicular-opposed-double platform flake cores ("change of orientation" cores) have two striking platforms aligned at roughly right angles to one another. Cores with more than two striking platform surfaces are usually classified as multiple-platform cores.

Neolithic core inventories often include tested clasts (pebbles and cobbles) and nodules. These artifacts are usually made of raw materials available in the local site environs, often materials markedly inferior to those found associated with blades and retouched tools in the same assemblages. These cores probably reflect raw material choices forced by increased pressure on local raw material sources arising from larger and more sedentary populations of lithic "consumers."

Many Neolithic assemblages feature elongated cores with irregular or sinuous lateral edges (Figure 7.2.a). These cores may be either bifacially or unifacially flaked. Flake scars on these pieces are relatively large and no effort appears to have been made to create a functional cutting edge. These artifacts are often called "roughouts," implying that they are incompletely finished celts. Calling them roughouts might be plausible for quarry sites or where there is evidence of systematic celt production; but, similar artifacts are also found at sites far from raw material sources and/or at habitation sites. There, they may reflect recycling of celts as flake cores, or even the intentional design of a large cutting tool. The artifact illustrated in Figure 7.2a, for example, could equally well be viewed as a large cutting tool or a celt roughout, depending on whether its broader edge is placed in the distal or proximal position. "Elongated flake core" is a more interpretation-neutral term for these artifacts.

Flake cores occur in most Neolithic assemblages, and they often rise to high proportions of the cores. Such high frequencies of flake cores may reflect greater use of "expedient" core reduction in response to increased sedentism (Parry and Kelly 1987). Many flake cores are very small, suggesting intense and prolonged reduction, again a phenomenon plausibly referable to sedentism.

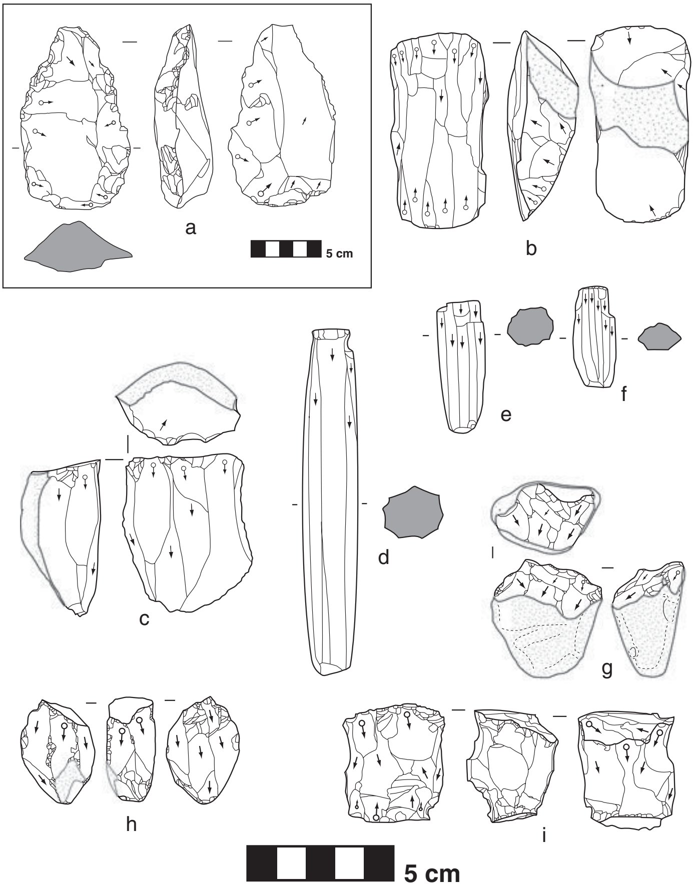


FIGURE 7.2. Neolithic cores. a. elongated flake core, b. bidirectional blade core, c. unidirectional blade core, d–f. bullet-shaped blade cores, g. chopper/tested pebble, h. single-platform unidirectional flake core, i. parallel-opposed bidirectional flake core. *Sources:* Ramat Tamar (a), Beidha (b), Sheikh Hassan (c), Bouqras (d–f), Ashkelon (g), Shar HaGolan (h), Netiv Hagdud (i). Redrawn after Abbès (2003), Alperson and Garfinkel (2002), Barkai (2005), Garfinkel and Dag (2008), Gopher (1994), Mortensen (1970), Nadel (1997), Roodenberg (1986).

Neolithic Blade Cores

Neolithic blade cores are comprised of two main groups of artifacts: unidirectional blade cores and bidirectional blade cores (Figure 7.2. b–f). Unidirectional blade cores are essentially elongated platform cores. They feature a single striking platform and single flake-release surface of varying lateral extent. Such cores are to be found in nearly every Neolithic assemblage of any great number. So-called bullet-shaped blade cores are conical unidirectional blade cores with long parallel flake scars covering nearly their entire surface. Bullet-shaped cores are more common in Late Neolithic contexts and in the northern Levant, and are often made of obsidian. Many researchers view them as resulting from systematic blade production by pressure flaking.

Neolithic bidirectional blade core technology, in contrast, was distinctive and highly standardized, geared, it seems, toward producing long, narrow blades with relatively straight profiles (Abbès 2003, Barzilai 2009, Nishiaki 2000, Quintero 2011). Neolithic bidirectional blade cores would be classified as "parallel cores" in the Conard et al. (2004) typology. All bidirectional blade cores involve blades being struck along parallel trajectories from striking platform surfaces aligned parallel to one another at opposite ends of a long, narrow flake-release surface (Figure 7.3). Three main variants of bidirectional blade cores are recognized. Naviform ("boat-shaped") bidirectional blade cores have a lower, unexploited volume that features a symmetrical bifacially flaked edge. This edge is aligned more or less parallel to the surface from which blades were detached. Postero-lateral bidirectional blade cores are similar to naviform cores except that the ridge on their ventral surface is positioned laterally, rather than symmetrically, to the blade-release surface. Bipolar bidirectional blade cores have no bifacially flaked ridge on their ventral surface. These cores can be further subdivided on the basis of blade removal sequences (Barzilai 2009). In the "predetermined upsilon" sequence, the removal of a blade with converging distal edges is followed by the removal of a blade with expanding ("upsilon"-shaped) distal edges from the opposite end of the flake-release surface. In the single-dominant platform sequence, long flakes detached singly or in sequence from one platform are followed by shorter flake removals from the other. In the "one-one-one" sequence, blade removals alternate between striking platforms, resulting in a series of pointed blades.

Flakes/Detached Pieces

Most unretouched flakes and flake fragments in Neolithic assemblages are rarely distinguished as more than débitage, although it is

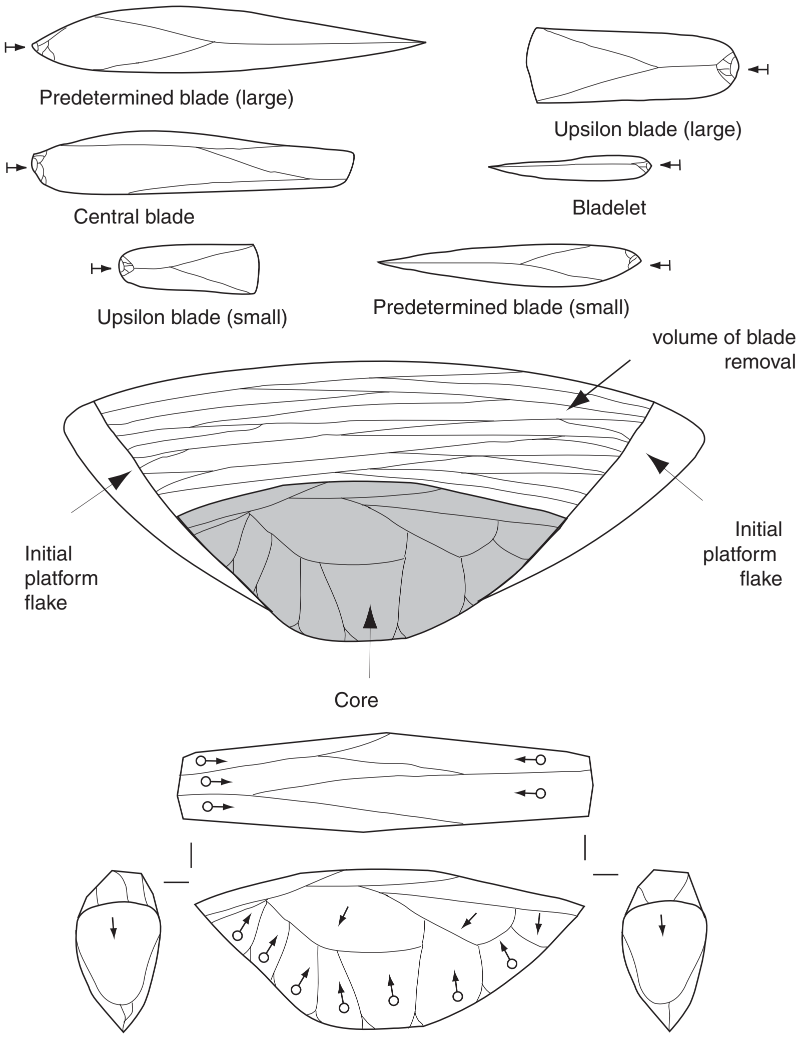


FIGURE 7.3. Schematic of bidirectional blade core reduction.

increasingly common for cortical/non-cortical flakes and whole/fragmentary flakes to be listed separately from one another. Cortical flakes are sometimes described as "primary elements." The main exceptions to this are prismatic blades, core-trimming elements (chiefly those related to blade cores), and tranchet flakes referable to the modification of celts. Biface-thinning flakes and flakes resulting from the initial shaping of celts and bifacial knives are rarely recognized as such, or if recognized, rarely illustrated.

Blades and Blade-Core Trimming Elements

Blades and core-trimming elements associated with blade production are the subject of many different classification schemes. A minimalist typology of these artifacts would include central blades, blades with cortical or steep margins, crested blades, and various blade-core repair/rejuvenation flakes (CUP Website Figure 37). Central blades are bilaterally symmetrical, cortex-free, and have roughly triangular or trapezoidal cross sections. Among central blades, analysts increasingly distinguish two symmetrical forms:, pointed blades and "upsilon" blades (blades with expanding lateral edges and dorsal scar ridges resembling the Greek letter upsilon, Y). Blades with cortical or steep edges are simply blades detached from the margins of the flake-release surface. For descriptions of crested blades and various blade-core rejuvenation flakes, see Chapter 5.

Other Core-Trimming Elements

Most descriptions of Neolithic flakes recognize various kinds of core-trimming elements related to blade production (i.e., crested blades, distal core-rejuvenation flakes, and core tablet flakes). The other major category of core-trimming flakes is tranchet flakes (Figure 7.4). Tranchet flakes are flakes detached from the distal end of flaked-stone celts by a fracture that propagates obliquely or perpendicularly to the artifact's long axis. Technologically analogous to Upper Paleolithic chanfreins, tranchet flakes can often be recognized by the presence of a use-damaged edge on their dorsal face. Tranchet flakes were used to modify the edges of celts ranging widely in size and shape, and as a result they vary widely as well. Tranchet flake detachment occurs mainly in earlier Neolithic contexts. It appears to have been replaced by edge-abrasion in later Neolithic contexts – possibly because abrasion conserves raw material better and involves less risk of catastrophic tool breakage than resharpening a celt by detaching a tranchet flake.

Flakes

How unretouched flakes are treated analytically in descriptions of Neolithic assemblages varies widely. Most analysts distinguish blades

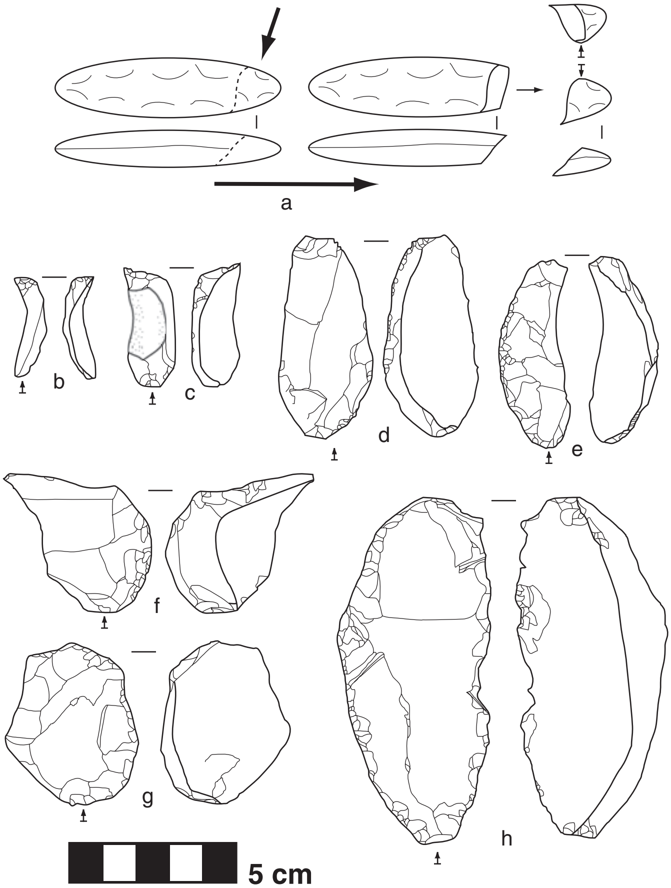


FIGURE 7.4. Neolithic celt tranchet flakes. a. schematic diagram of celt tranchet flake formation, b–h. celt tranchet flakes. *Sources:* Netiv Hagdud. Redrawn after Nadel (1997).

from flakes. Increasingly, analyses publish statistics on length, width, thickness, and other key dimensions. It is sometimes less than clear which particular variants of these measurements are being recorded (i.e., whether it is technological or morphological length, maximum thickness, or midpoint thickness). Dorsal surface attributes usually note presence/absence of cortex and scar directionality (i.e., converging, parallel, orthogonal, etc.). Striking platform attributes usually note whether this surface is cortical, plain, dihedral, or facetted.

Obsidian Sub-Assemblages

When Neolithic assemblages contain obsidian artifacts, they are usually tabulated and described separately from the flint/chert artifacts. Obsidian occurs naturally in Anatolia and along the northern flanks of the Levant. During the Neolithic, obsidian artifacts begin to occur in assemblages further south. The specific forms in which obsidian occurs varies widely, but common forms include conical bullet-shaped cores, bladelets, projectile points, knives, and backed/truncated pieces and small flakes/flake fragments (Braidwood 1961). Obsidian artifacts are usually smaller and more extensively retouched than non-obsidian artifacts in the same assemblage. This suggests there were systemic differences in the curation of obsidian versus non-obsidian artifacts. Except for the possibility that obsidian blades were detached by pressure, the techniques used to reduce obsidian cores and to retouch obsidian flakes into other artifacts do not differ from those used on flint. Obsidian source-tracing and distance-decay analysis (Cann, Dixon, and Renfrew 1969) suggest obsidian was brought to the southern Levant by "down-the-line" exchange networks, ones in which a small amount of the obsidian was extracted by each party in a series of exchanges.

Pounded Pieces

Neolithic pounded pieces can be divided into ad hoc hammerstones (percussors and retouchers) and shaped percussors (facetted stones and stone balls) (see Figure 7.5). Percussors are flakes, blades, cores, and elongated pebbles featuring concentrations of crushing, microfracturing, and abrasion. Mortensen (1970) distinguished a subset of percussors as "firestones" suggesting they may have been used to start fires by percussion. Retouchers are elongated pieces with pitting, striations, and other damage referable to use as a pressure-flaker. Facetted stones are rocks that have one or more flat facets formed by percussion and/or abrasion. Stone balls are spherical artifacts whose surfaces are covered with pitting comminution and other percussive and abrasive damage. Damage similar to that on ad-hoc hammerstones, stone balls, and facetted stones is similar to that caused by prolonged use of flint and other hard stones for shaping groundstone artifacts by

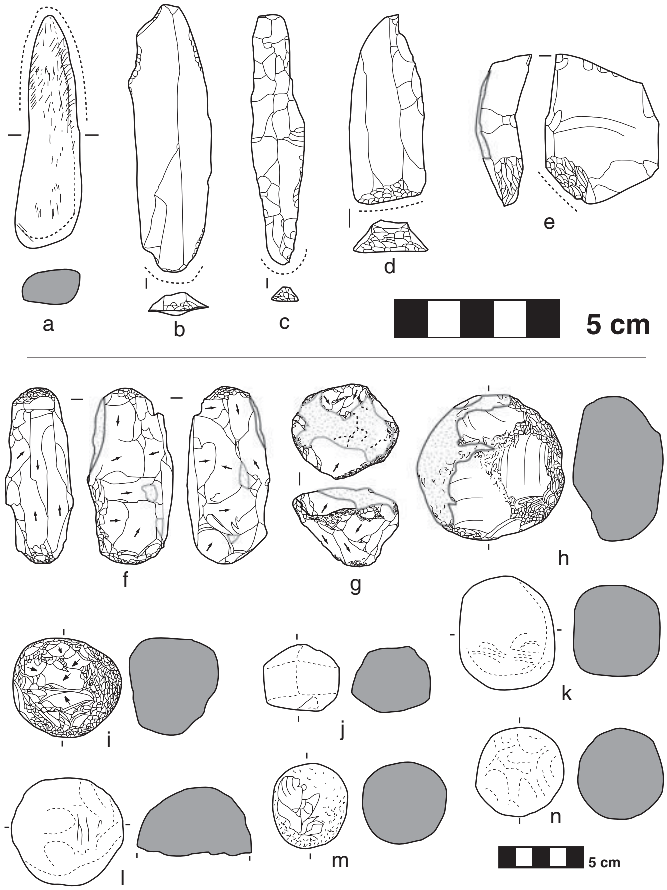


FIGURE 7.5. Neolithic retouchers and pounded pieces. a–c. retouchers, d–e. firestones, f–h. ad hoc hammerstones made from cores, i–k. facetted stones, l–n. stone balls. *Sources:* Ashkelon (g, k–l), Beidha (b–e, m), Jericho (n), Kfar HaHoresh (f, h–i), Netiv Hagdud (a, j). Redrawn after Dag (2008b), Dorrell (1983), Gopher (1997), Goring-Morris et al. (1994–5), Mortensen (1970). Dotted lines indicate areas of focused striations and microfractures. Note differences in scales of a–e vs. f–n.

percussion (Stearcy 2011). To some degree Neolithic ad-hoc hammerstones, facetted stones, and stone balls grade into a series of more extensively use-damaged artifacts. There is also some overlap between Neolithic pounded pieces and mortars and handstones used with pulverizing equipment (see the discussion later in this chapter and Wright 1992).

Groundstone

Although groundstone tools are among the most distinctive and derived lithic components of Neolithic stone tool technology, little is known about how these tools were produced. On the basis of experiments and ethnographic studies (Dickson 1980, 1982; Stearcy 2011; Toth, Clark, and Ligabue 1992), Neolithic celts, grinding stones, pestles, and other groundstone artifacts are thought to have been shaped by cycles of percussion and abrasion. Softer rocks, such as limestone and steatite might have been shaped by actual carving or drilling. Few tools, however, have been specifically identified as aids to groundstone tool production. Recent groups who make groundstone tools often "recycle" stone tools as percussors (Simms 1983). There is no reason to believe this is a recent phenomenon, and it follows that Neolithic cores and celt fragments with extensive crushing and comminution may have become damaged in groundstone tool production. It remains unknown whether such damage can be distinguished from that resulting from flintknapping.

The stone balls noted at some Neolithic sites may be referable to groundstone tool production, as well as to other tasks. As Schick and Toth (1994) demonstrated, after prolonged use and rotation in the hand, angular stone fragments used as percussors can gradually acquire a spherical shape. When they become spherical, it can be difficult for their user to keep their fingers away from the active part of the tool during use. If this model of stone ball formation is correct, then Neolithic stone balls may be percussors discarded after extremely prolonged use. Alternatively, it is possible that they were deliberately used for some other purpose for which a spherical stone is desirable. Stone balls, not unlike those found at Neolithic sites, were used ethnographically as bola stones and (enclosed in leather) as the striking end of clubs (Clark 1955).

III. NEOLITHIC FLAKED STONE TYPOLOGY

More so than in earlier prehistoric periods Neolithic artifact typology has a strong "functional" character. Names for major categories of artifacts often imply a particular assumed function, such as core-tools, celts, projectile points, knives, and sickle inserts. These artifacts have been the focus of considerable research and patterns in their variability are thought to have economic and/or cultural historical significance for Levantine prehistory.

Core Tools

Neolithic assemblages feature relatively large cores that appear to have been shaped for cutting tasks. Picks and heavy-duty core tools are also found in most assemblages, even though they are rarely subdivided to the same extent as celts (discussed later in this chapter).

Picks

Most Neolithic picks are elongated bifaces with a convergent distal tip (Figure 7.6). This tip may be either bifacial or trihedral. The proximal end of the pick is usually relatively thick. It may be bifacially or unifacially flaked, or it may remain covered in cortex. Neolithic picks differ little from Lower Paleolithic picks, except that there is often macroscopic use-related fracturing, abrasion, and polish at their distal ends. The main feature that unites Neolithic picks is the admittedly subjective assessment that they are thought too large and/or too asymmetrical to have been hafted.

Heavy Duty Tools

A "heavy-duty tool" is a kind of catch-all category for large retouched artifacts that fit in no other formal tool category. Neolithic heavy-duty tools are usually cores or large flakes that have had some degree of shaping retouch applied to them. This retouch is of such a small scale that it is seen as the shaping of a functional cutting edge, rather than as a byproduct of flake production. This imposition of a kind of functional edge differentiates heavy-duty tools from elongated flake cores and other core types.

Celts (Axes, Adzes, Chisels)

Neolithic celts are core-tools, roughly rectangular in plan view, subrectangular in cross section, with one distinctively modified working edge at their distal end (Barkai 2005). Technologically, celts can be divided into flaked-stone celts (shaped primarily by conchoidal fracture) and groundstone celts (shaped by percussion and abrasion). In actuality, many flaked-stone celts have some degree of abrasion and polishing on their working edge and/or other surfaces. Flaked stone celts are made mainly of flint/chert, while groundstone celts are most often made of basalt and less often of limestone, chert, or other rock types. Typologically, celts are usually divided into axes, adzes, and chisels (CUP Website Figure 38). Many researchers also recognize celts smaller than 5 cm in length as a distinct "miniature celt" category, either on its own or as a subtype of axes, celts, or adzes. The taxonomic distinction among axes, adzes, and chisels reflects assumed functional differences. On axes, the working edge is aligned parallel to the plane of movement during use, and parallel to the handle to which they are attached. In contrast, adzes' working edges are aligned orthogonally to the plane of tool motion and perpendicularly to the shaft of the handle to which they are attached. Chisels are thought to have been used while held in the hand and propelled by percussion of their proximal end. By convention, in drawings, the working edge of a celt is treated as its distal end.

On flaked-stone celts, the working edge may be shaped by retouch (unifacial or bifacial), by one or more tranchet flake removals, or by abrasion/polishing. These edge modification techniques crosscut the axe/adze/chisel typological distinctions. Descriptions of Neolithic celts differ in the degree to which they subdivide celts along lines of working edge modification. Similarly, celt typologies also vary in the degree to which various kinds of celts are distinguished from one another (i.e., axes from adzes, or adzes from chisels) on the basis of plan view shape and cross section.

Axes are biconvex in cross section with working edges usually greater than 20 mm wide. The sizes and plan shapes of Neolithic axes vary widely (Figure 7.7). In older literature, axes (and some adzes) whose working edges were shaped by tranchet flake removals are described as "Tahunian" axes/adzes.

Adzes are usually plano-convex in cross section, with the flatter surface being treated as the "ventral" surface (Figure 7.8). The dorsal surface is usually either trapezoidal or triangular in cross section. Adzes' working edges are usually wider than 20 mm and shaped by either bifacial flaking, abrasion, or (less often) transverse flake removals. In theory, one could subdivide adzes (or chisels, see discussion later in this chapter) into subtypes along the same line as axes, but in practice, most reports of Levantine Neolithic celts do not. Most Neolithic adzes

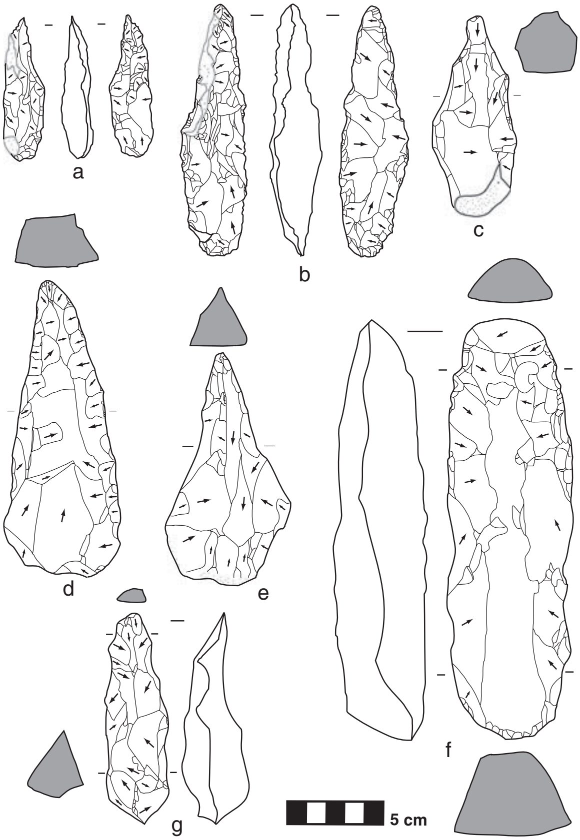


FIGURE 7.6. Neolithic picks,a–e, g. picks, f. pick/large adze. Sources: Netiv Hagdud (a–b), Beidha (c–e), Gesher (f–g). Redrawn after Mortensen (1970), Nadel (1997), Nadel and Garfinkel (Dani Nadel and Garfinkel 1989).

have lateral edges that are either roughly parallel to one another, or either slightly tapering or biconvex. Tel Mureybit features a distinctive series of adzes made on large flakes with broad distal edges, concave lateral edges and narrow tapering tangs. Small adzes (<5 cm long) are sometimes distinguished as "micro-adzes." Other than in their thickness (>1 cm), these micro-adzes grade into chisels and even larger transverse arrowheads.

Chisels are long and narrow with a working edge that is 20 mm or less in length (Figure 7.9). They vary widely in length and edge modification, but their cross sections are roughly square. Comminution, crushing, and bending fractures on the proximal ends of some

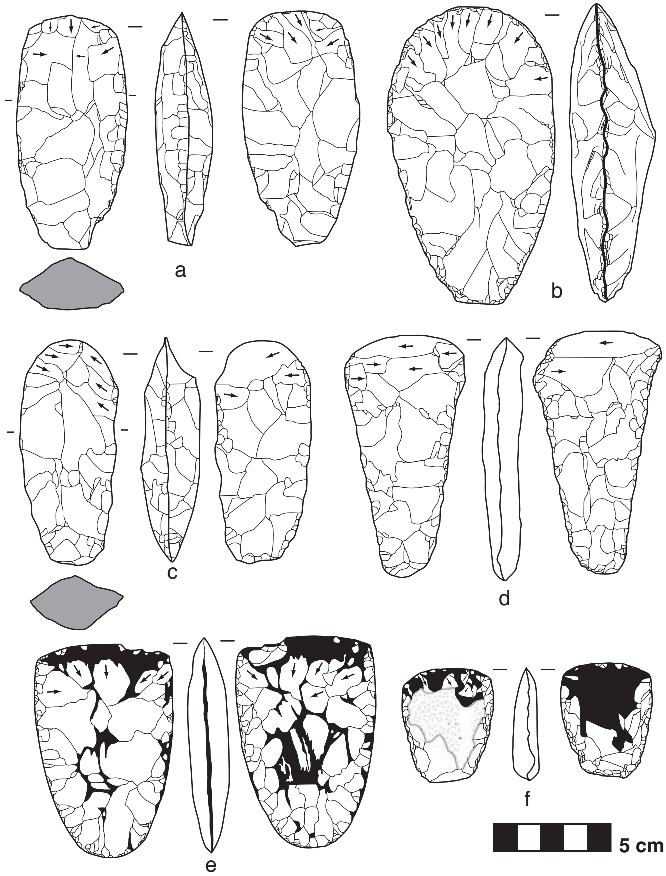


FIGURE 7.7. Neolithic Axes. a–b. bifacially-retouched edge, c–d. tranchet edge, e–f. abraded and polished edges. *Sources:* Beidha (a, c), Abu Ghosh (b), Netiv Hagdud (d), Yiftahel (e), Nahal Zehora II, Level 4 (f).Redrawn after Mortensen (1970), Barkai (2005).

chisels suggest they were used with indirect percussion, but many other chisels lack such damage.

Descriptions of Neolithic assemblages differ over whether groundstone celts (celts shaped wholly by grinding and polishing) are tabulated together with flaked-stone celts, or treated together with the other groundstone tools.

There is considerable variability in how Neolithic celts are described. Axes/adzes and chisels grade into one another and some reports do not distinguish among them. Most descriptions of complete

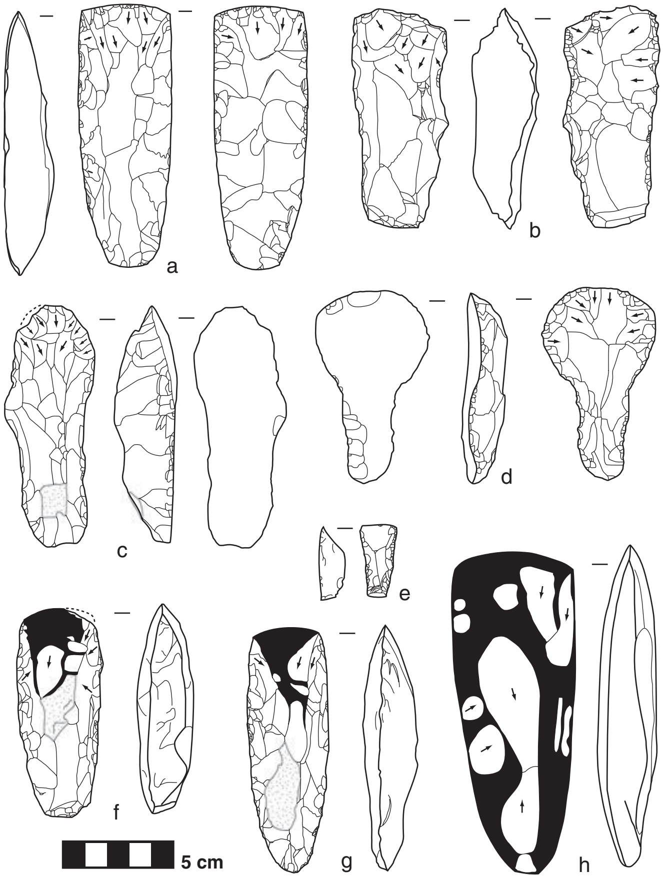


FIGURE 7.8. Neolithic Adzes. a–b. bifacially retouched edge, c–d. unifacially retouched edge, e. micro-adze, f–h. abraded and polished edge. *Sources:* Byblos (a, e–h), Nahal Zehora 1 (b), Mureybit (c–d). Redrawn after Barkai (2005), Cauvin (1968), and Sánchez Priego (2008).

celts distinguish chisels from axes/adzes. Some subdivide axes by edge-modification, but not adzes or chisels. Most descriptions distinguish flaked-stone celts from groundstone ones, but others may combine flaked-stone celts modified by abrasion/polishing with groundstone celts. Descriptions of Neolithic assemblages sometimes tabulate celt fragments. Again, there is considerable variability in whether or not these fragments are attributed to specific types of celts. The "Huleh break" (Barkai 2005: 31) is a large bending fracture observed on many celt fragments. This kind of break is thought to reflect damage during use. Far more often, however, celt fragments are broken by lateral fractures of indeterminate origin (CUP Website Figure 39). Many Neolithic celt fragments were recycled as cores and/or as ad-hoc hammerstones.

Over the course of the Neolithic, axes decrease in frequency while adzes and chisels become more abundant (Barkai 2011: 45; CUP Website Figure 40). There are also shifts in the ways celts' working edges were maintained and rejuvenated. PPNA contexts feature flint celts shaped by tranchet blows and celts made of basalt and limestone and shaped by grinding and polishing their entire surface. The tranchet-resharpening strategy did not last long, and by the PPNB, flint celts were instead being shaped by abrasion. This abrasion was mainly focused on shaping and maintaining the working edge and on flattening ridges on the central parts of dorsal and ventral surfaces. PPNB celts were also significantly larger than PPNA ones. Chisels and adzes begin to eclipse axes during Late Neolithic times and continue to dominate bifacial tool assemblages into the Chalcolithic. Barkai interprets this shift as reflecting a change from axes intended mainly for land clearance and heavy-duty tasks (i.e., architectural carpentry) to a more differentiated toolkit – chisels for precision work and adzes as versatile tools capable of either light or heavy-duty work. Barkai (2011) also makes a strong case for the emergence of a symbolic dimension to axe/adze production, citing instances of caching and use as mortuary furniture.

Projectile Points

Most Neolithic projectile points are either triangular or bi-conical pieces of varying degrees of elongation (Cauvin 1974a, Gopher 1994, Kozlowski and Aurenche 2005). Most are between 2 and 10 cm long and less than 3cm wide and have a retouched tip and some basal modification for hafting. The most notable exceptions to this pattern occur in the earliest and latest Neolithic contexts in which truncated triangular/trapezoidal flake fragments were manufactured. Neolithic projectile point types can be discussed in terms of seven major groups: Harifian points, South Levant Early Neolithic types, North Levant Early Neolithic types, Helwan points, elongated PPNB points, short Late Neolithic points, and segmented pieces/transverse arrowheads

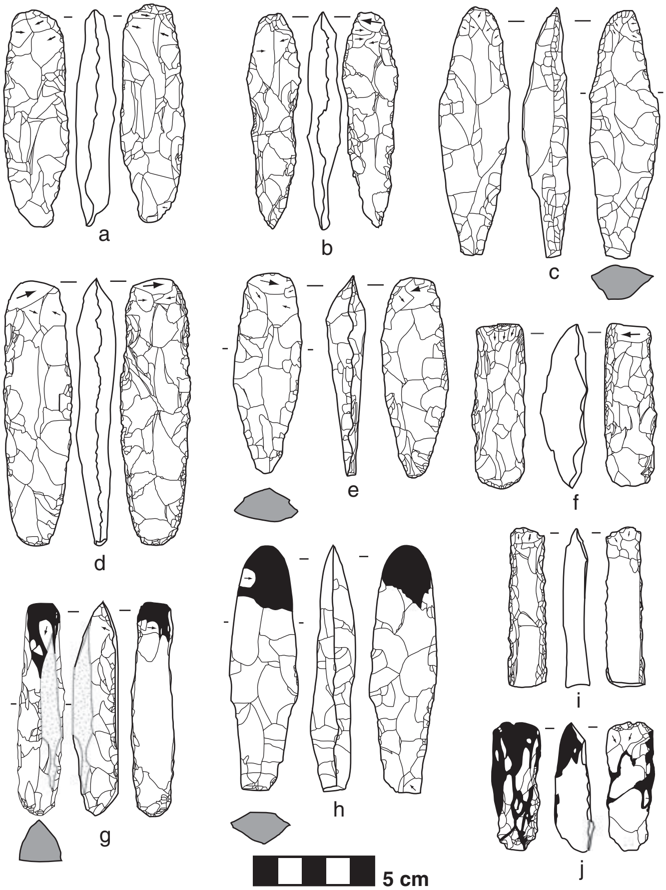


FIGURE 7.9. Neolithic Chisels. a, c, i. bifacially retouched edge, b, d–e. tranchet edge, g–h, j. abraded and polished edge. Sources: Netiv Hagdud (a–b, c), Beidha (d–e, h), Nahal Zehora I (f, i, j), Natzur (g). Redrawn after Mortensen (1970), Barkai (2005).

(Table 7.4). Most of the typological distinctions among these points revolve around modification of the base (proximal end) and the shape of the blade (medial and distal end).

Harifian points (Figure 7.10.a–i) occur mainly in "Harifian" late Epipaleolithic/early Neolithic assemblages from the Negev and Sinai (see Chapter 6). The major Harifian point types include Harif, Ounan, and Shunera points (Goring-Morris 1992). All are microlithic points similar to those of the Epipaleolithic period. Harif points are elongated pointed bladelets whose blade is formed by the convergence of one

Table 7.4. *Neolithic Projectile Point Types*

Major Projectile Point Categories	Specific Point Types
Harifian points	Harif point
	Ounan point
	Shunera point
South Levant Early Neolithic/PPNA types	el-Khiam point (sensu stricto)
	Salibiya point
	Jordan Valley point
	Abu Maadi point
North Levant Early Neolithic types	Güzir point
	Qaramel point
	Nemrik point
	Demirköy point
	Jerf el-Ahmar point
	Nevali Çori point
	Mureybit point
elwan points	Sheikh Hassan point
	Aswad point
	Abu Salem point
Elongated Points	Jericho point
	Byblos point
	Amuq point
	Intermediate Jericho-Byblos point
	Intermediate Byblos-Amuq point
Short Late Neolithic points	Ha-Parsa point
	Nizzanim point
	Herzliya point
Segmented pieces	Transverse arrowhead

backed and one unretouched edge. Their base features a short pointed retouched tang. Ounan points also feature a short, pointed tang, but they are somewhat less elongated than Harif points and otherwise unretouched or minimally retouched. Shunera points are short scalene triangles with flat or shallow concave truncated bases and retouch along one lateral edge.

South Levantine Early Neolithic points include El Khiam and Abu Maadi points (Figure 7.10. j–w, x–dd).

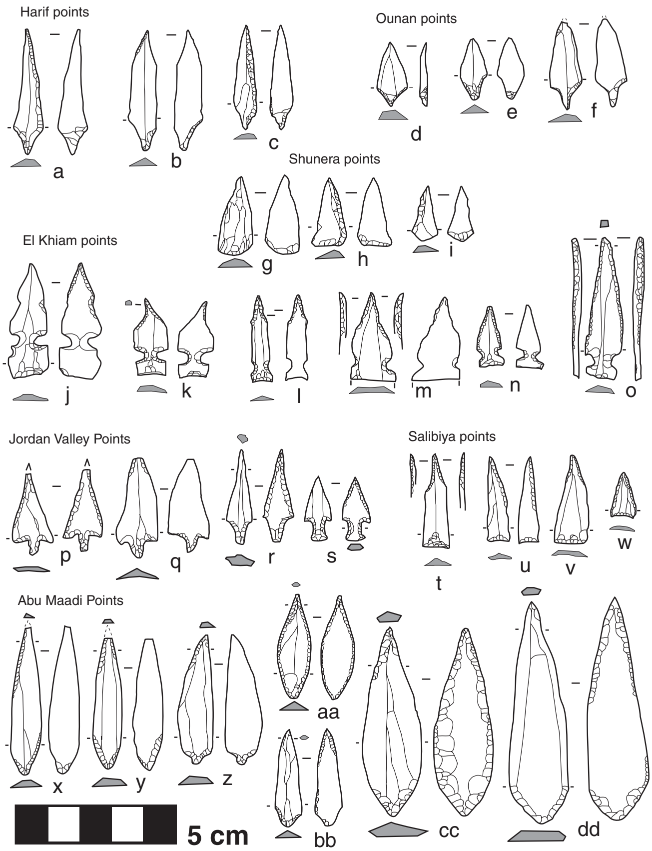


FIGURE 7.10. Harifian and South Levantine Early Neolithic points. a–c. Harif points, d–f. Ounan points, g–i. Shunera points, j–o El Khiam points (sensu stricto), p–s. Jordan Valley points, t–w. Salibiya points, x–dd. Abu Maadi points. Sources: Abu Salem and various Harifian sites (a–i), Netiv Hagdud (j–w), Abu Maadi 1(x–aa), Mureybit (bb–dd). Redrawn after Cauvin and Abbès (2008), Gopher (1994); Goring Morris (1992); Gopher, Bar-Yosef and Nadel (1991).

El-Khiam points (*sensu lato*) are short points made on a small bladelet with either a concave base and/or lateral notches. A heterogeneous grouping of mainly PPNA artifacts, El-Khiam points are subdivided into el-Khiam points (*sensu stricto* or *ss*), Salibiya points, and Jordan Valley points (Gopher, Bar-Yosef, and Nadel 1991). El-Khiam (ss) points are triangular points with side-notches and a flat or shallowly concave base (Figure 7.10.j–o). The side-notches, generally seen as an aid to hafting, are usually located near the base, but some examples have notches at or beyond the midpoint of their length. Jordan Valley points and Salibiya points lack these side-notches. A Jordan Valley point features a thick tang that may be convergent, straight, or expanding (Figure 7.10.p–s). Salibiya points lack a tang and instead have bases that are either flat, slightly concave, or with a very small tang-like projection (Figure 7.10.t–w).

Abu Maadi points are narrow, thin points made on a small blade or bladelet and shaped by abrupt or semi-abrupt retouch (Figure 7.10. x–dd). They are widest near their proximal end. There are two subtypes, which differ in the shape of their bases. Subtype 1 Abu Maadi points have bases that are roughly triangular or slightly rounded and whose edges converge at a relatively open angle. Subtype 2 Abu Maadi points have a short tang shaped by shallow corner-removals. Abu Maadi points are found mainly in the southern Levant, at Abu Maadi 1, and elsewhere in the southern Sinai. Some large and small points from Mureybit closely approximate the Abu Maadi template.

Kozlowski and Aurenche (2005) identify seven further Neolithic point types that are found mainly in the northern Levant (Figure 7.11). Many of these points feature abrupt or invasive retouch on the ventral side of their distal end, presumably an effort to create a rounder tip cross section that is less vulnerable to bending fractures. Güzir points are essentially large el-Khiam points (*sensu stricto*) (see Figure 7.11.a–b). Qaramel points appear to be a North Levantine counterpart of the Jordan Valley point with a slightly broader and more distally widened tang (Figure 7.11.c–d). The Jerf el Ahmar point is similar to the Abu Maadi point, differing mainly in having a rounded or pointed tang (Figure 7.11.k–m). Nevali Çori points are elongated with a flat or concave base (Figure 7.11.n–o). The Nemrik point is roughly rhomboidal in plan view with distal and basal points shaped by backing and shallow retouch often on the ventral face (Figure 7.11.e–g). Demirköy points seem to be a larger and longer version of the Nemrik point with a somewhat more distinctive tang (Figure 7.11.h–j). They are found everywhere Nemrik points are and these point types grade into one another. Mureybit points are made on blades and feature a short tang formed by corner removals (Figure 7.11. p–t).

Helwan points are triangular points with varying combinations of one or more pairs of bilaterally symmetrical notches and tangs formed

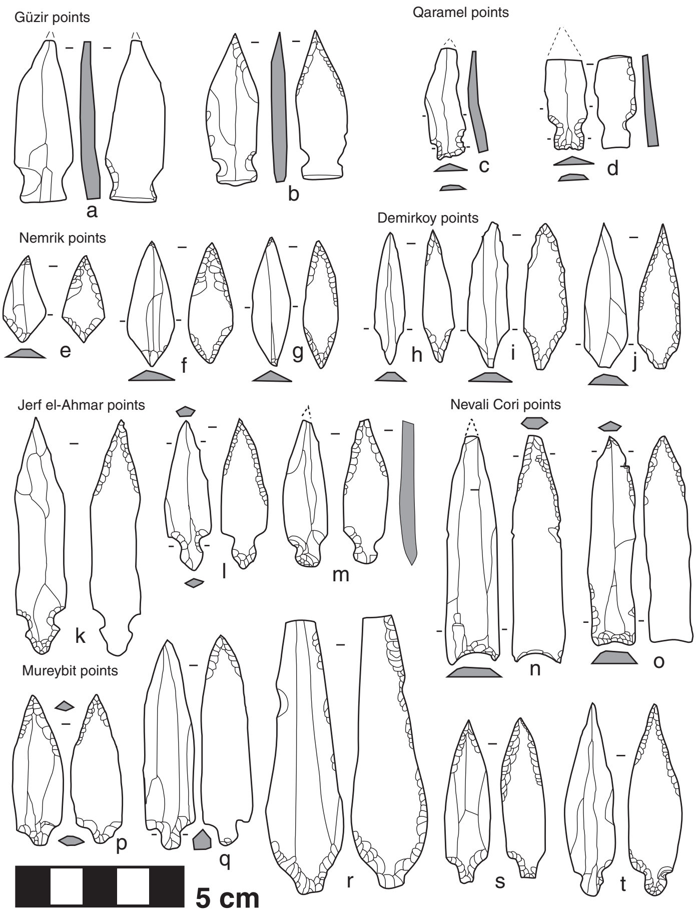


FIGURE 7.11. North Levant Neolithic points. a–b. Güzir points, c–d. Qaramel points, e–g. Nemrik points, h–j. Demirköy points, k–m Jerf el-Ahmar points, n–o. Nevali Çori points, p–t. Mureybit points. Sources: Demirköy (a, i–j), Jerf el-Ahmar (k, m), Nemrik (e–h), Nevali Çori (n–o), Sheikh Hassan Lower (b–d, l), Tel Mureybit (p–t). Redrawn after Kozlowski and Aurenche (2005).

by corner notches or corner removals (Figure 7.12). Retouch is often flat and invasive. Gopher (1994) treats Helwan points as a single widely variable group, while Aurenche and Kozlowski (2011) recognize three distinctive variants: the Sheik Hassan, Aswad, and Abu Salem points (see also Cauvin 1974a). Sheik Hassan points have a narrow body, lateral notches, and a narrow tang (Figure 7.12.a–f). Aswad points are relatively long (>3 cm in length), have a wide tang, and feature one or more pairs of lateral notches on their blades (Figure 7.12.g–k). Abu Salem points have narrow tangs and proximally projecting "wings" formed by corner-notches (Figure 7.12.l–q). Sheikh Hassan points are found mainly in the northern Levant, Abu Salem points mainly in the South, and Aswad points more in the central Levant. Most Helwan points are relatively small (5–8 cm), but larger examples of each point type also occur (Figure 7.12.r–u). Aswad points show up in some Early Neolithic contexts, but Helwan points are mainly associated with Middle Neolithic contexts.

Elongated points include Jericho, Byblos, and Amuq types, which mostly occur in PPNB contexts (Figure 7.19). Most of these points are made on blades, and some feature bases shaped by invasive and elongated scars thought to be the result of pressure-flaking. These points differ from one another with respect to basal and/or side notching, the shapes of their tangs, and the presence/absence of shoulders and/or "wings" and denticulations along their lateral edges. Jericho points are made on a flat (i.e., non-curved, non-twisted) blade with a relatively long contracting tang that is formed by removals from the base and corners (Figure 7.13.a–e). Less common features of Jericho points include denticulated lateral edges, elongated straight tangs, and tangs from which barbs project laterally. Byblos points are made on a blade with a tapering tang (Figure 7.13.f–k). The line between the lateral edges and the tang is either smoothly tapering or marked by a shallow notch. The angle at which this notch and the lateral edge converge is usually less than 160 degrees. Some Byblos points feature a pair of laterally projecting barbs near the base of their blade. Amuq points are foliate points made on a blade with a tang that tapers to a sharply convergent point (Figure 7.13.l–q). Intermediate Jericho-Byblos points feature a tapering tang, a barb on one side, and a shoulder on the other. Intermediate Byblos-Amuq points feature a tang that tapers to a sharply convergent point along one edge and that is shouldered on the other edge. Large examples of elongated points are sometimes classified as knives, daggers, or spear points (see knives, later in this chapter).

Short Late Neolithic points include the Ha-Parsa, Nizzanim, and Herzliya types (Figure 7.14). These points are usually less than 4 cm long and feature extensive retouch. Ha-Parsa points have a triangular blade and are made on a flake or blade/bladelet (Figure 7.14.a–k). Their tangs are either tapering or biconvex and set off from the

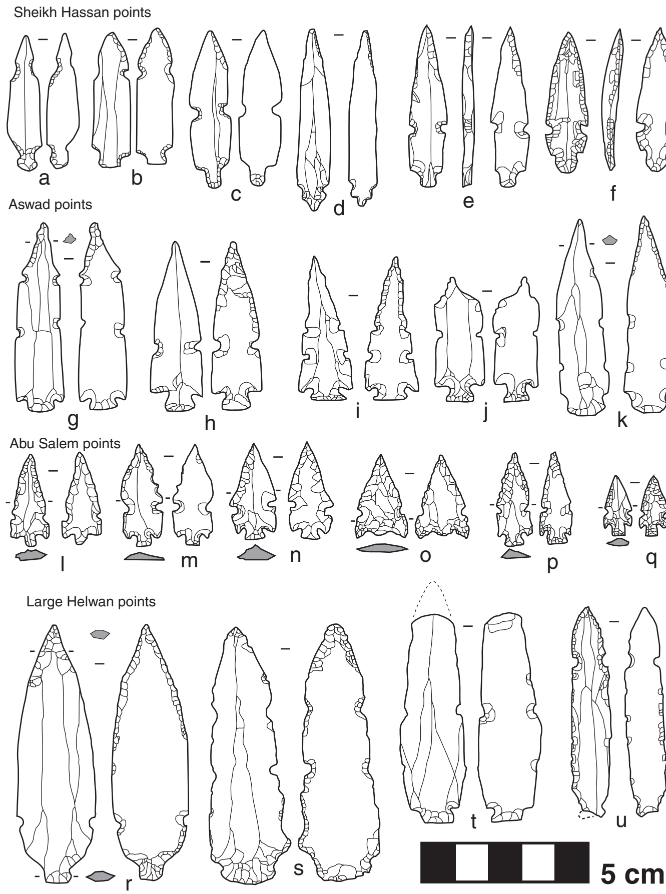


FIGURE 7.12. Helwan points. a–f, r. Sheikh Hassan points, g–k, s–u. Aswad points, l–q. Abu Salem types. Sources: Mureybit (a–c, k, r, t, u), Beidha (e–f), Aswad 1 (g), Nahal Oren (h, s), Horvat Galil (i), Jericho (j), Abu Salem (l–n), Nahal Lavan 109 (o–q). Redrawn after Kozlowski and Aurenche (2005), Cauvin and Abbès (2008), Crowfoot-Payne (1983), Gopher (1994), and Mortensen (1970).

lateral edges by deep notches. Nizzanim points are made on flakes or blades/bladelets (Figure 7.14.s–cc). They have relatively straight or slightly convex lateral edges, rounded shoulders, and a tapering tang. Herzliya points are made on flakes (Figure 7.14.l–r). Their lateral edges are straight or slightly convex and not set apart from the tang by any notching. These points grade into one another in much the same way that Jericho, Byblos, and Amuq points grade.

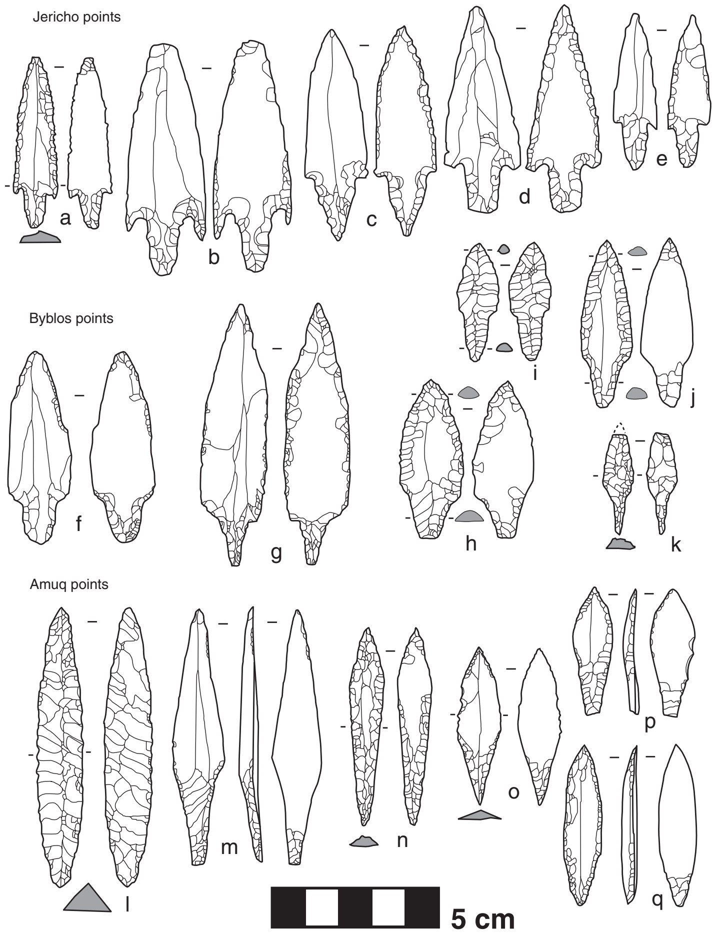


FIGURE 7.13. Elongated points. a–e. Jericho points, f–k. Byblos points, l–q. Amuq points. Sources: Abu Salem (a), Jericho (b–e), Abu Ghosh (f–g), Mureybit (h–j), Kadesh Barnea 301 (k), Byblos (l), Beidha (m, p–q), Ujrat el-Mehed (n), Nahal Issaron (o). Redrawn after Crowfoot-Payne (1983), Gopher (1994); Mortensen (1970).

There is considerable variability among Jericho, Byblos, Amuq, Ha-Parsa, Nizzanim, and Herzliya points. Some Ha-Parsa, Nizzanim, and Herzliya points appear to be scaled-down versions of Jericho, Byblos, and Amuq points with somewhat more invasive retouch. Some of the wide variability among all these Neolithic points probably reflects patterns of repair, resharpening, and recycling (e.g., using points as drills or knives).

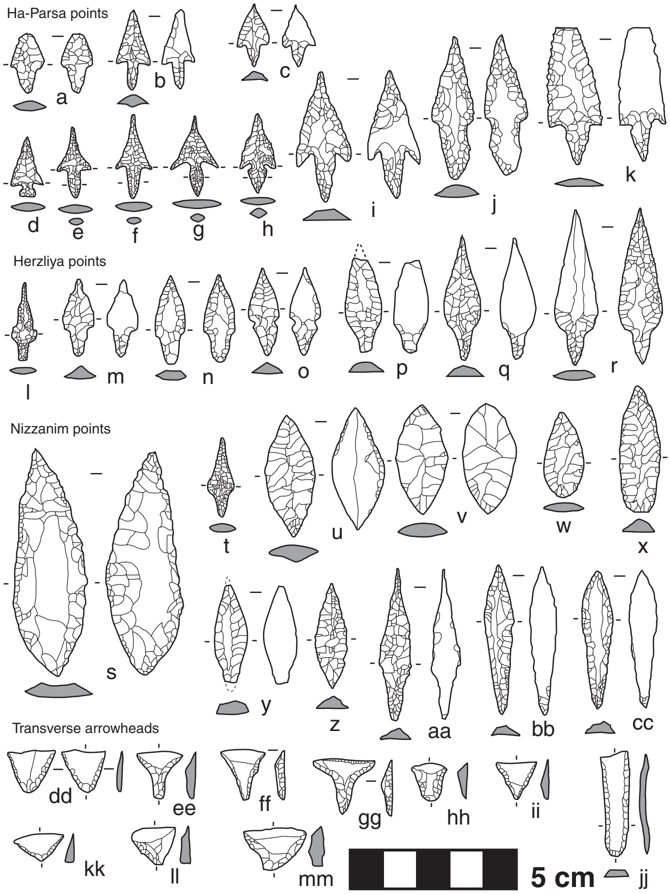


FIGURE 7.14. Later Neolithic points and transverse arrowheads. a–k. Ha-Parsa points, l–r. Herzliya points,s–cc. Nizzanim points, dd–jj. transverse arrowheads. *Sources:* Nahal Issaron (a–c, q–r, z–cc), Givat Ha-Parsa (d–h, l, t, w), Nahal Seker 81–A (i–k, s, x), Sha'ar Hagolan (m–p, y), Nizzanim (u), Kvish Harif (v), Herzliya (dd–jj), Nahal Hemar (kk–mm). Redrawn after Redrawn after Alperson and Garfinkel (2002), Gopher (1994), Gopher et al. (1994).

Segmented pieces, or transverse arrowheads, are flake or blade segments more or less trapezoidal or triangular in plan view with either straight or concave truncations at their distal and proximal ends (Figure 7.14.dd–mm). The longer of the two unretouched lateral edges is thought to be the principal cutting edge, while the shorter edge is thought to have been set in an arrow shaft. In the southern Levant, transverse arrowheads are found mainly in Late Neolithic contexts.

Archery experiments using transverse-mounted Epipaleolithic projectile points, close morphological analogs for Neolithic segmented pieces, show impressive durability (Yaroshevich et al. 2010). The reappearance of transverse mounted projectile points in the Late Neolithic and a trend toward smaller projectile points could herald a shift to smaller bows and arrows, a focus on smaller game and/or the use of poison (measures that might make sense if larger game were being depleted by growing and increasingly sedentary Neolithic human populations).

Neolithic projectile points are routinely described as "arrowheads" in the archaeological literature, but their actual modes of use were likely more variable. Many are so large and thick in cross section that they are plausibly interpretable as spearthrower darts, knives, or even perforators/drills. A number of "arrowheads" from Tell Halula (Syria) feature "sickle polish" from use as reaping knives (Molist and Borrell 2007).

Gopher's (1994) seriation analysis shows several chronological patterns among Levantine Neolithic projectile points (Table 7.5 and CUP Website Figure 41). Points based on bladelets, such as El Khiam points and Abu Maadi points, are mainly found in Early Neolithic contexts. Elongated forms, such as Helwan, Jericho, Byblos, and Amuq points, are mainly found in Middle Neolithic (PPNB/C) contexts, where their occurrence is correlated with elongated blade cores; however, examples are also known from Early and Later Neolithic contexts. Shorter points, such as the Ha-Parsa, Nizzanim, and Herzliya types, and transverse arrowheads are mainly known from Late Neolithic contexts. Gopher's research also reveals differences in the chronological occurrence of different projectile point types between the northern and southern Levant. Helwan points, for example, occur earliest in the North and later spread to the South. Artifacts similar to Helwan points are also known from Egyptian Neolithic sites.

Gopher (1994) views major diachronic changes in Neolithic projectile point form as arising from changes in hunting weapon technology. This is possible – in fact, probable. Among recent stone-tool-using hunters, larger points are often used to tip weapons that kill by shock and hemorrhage (Ellis 1997). Smaller points are often used in conjunction with poison (Bartram 1997). Variability among Neolithic projectile points, however, was almost certainly not determined by a

Table 7.5. *Chronology of Neolithic Projectile Point Types*

Point Type	Early Neolithic	Middle Neolithic	Late Neolithic
Harif point	+		
Ounan point	+		
Shunera point	+		
el-Khiam point	+		
Abu Maadi point	+		
Guzir point	+		
Qaramel point	+		
Jerf el-Ahmar point	+		
Nevali Çori point	+		
Mureybit point	+		
Nemrik/Demirköy point	+	+	
Helwan points	+	+	
Jericho point	+	+	+
Byblos point	+	+	+
Amuq point	+	+	+
Ha-Parsa point			+
Nizzanim point			+
Herzliya point			+
Transverse arrowhead			+

single variable. Ethnographic studies show projectile technology varying in response to hunting strategies, warfare, and social factors as well (Churchill 1993, papers in Knecht 1997).

Knives

Larger pointed retouched tools in Neolithic assemblages are often described as knives (or daggers or spear points). Neolithic knives encompass a wide range of technological, morphological, and metric variation. There are four major categories: large projectile points/knives, knife-blades, bifaces, and knives on tabular flint pieces. Large projectile points/knives are Amuq, Byblos, and (less frequently) Jericho points that are longer than 10 cm and/or greater than 3 cm wide (Figure 7.15). Knife-blades are either blades or elongated subrectangular flakes with backing or marginal retouch or blades with

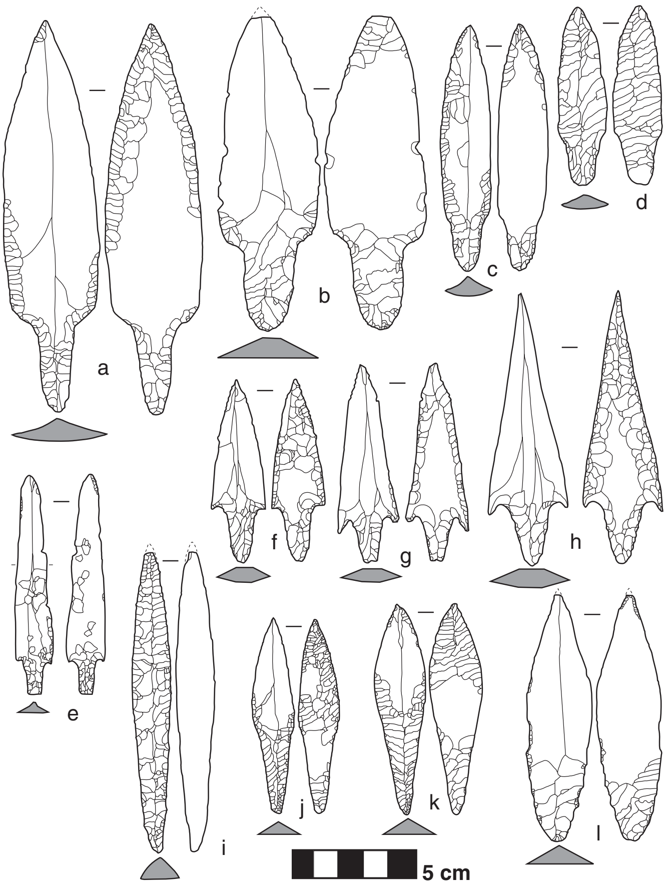


FIGURE 7.15. Neolithic knives/large projectile points. a–d. Byblos points, e–h. Jericho points, i–l. Amuq points. Sources: Byblos (a–d, i–l), Munhata (f–h), Nahal Hemar (e). Redrawn after Gopher (1994).

retouched tips and/or bases (Figure 7.16). The Beit Taamir knife (Figure 7.16.a) is a knife-blade with bifacial retouch along one edge (Crowfoot-Payne 1983). The Nahal Hemar knife (Figure 7.16.k–l) is a pointed blade with side-notches near its base (Bar-Yosef and Alon 1988). Neolithic "bifacial" knives vary from pieces with invasive retouch all over their surface to pieces on which retouch is invasive on one face only (Figures7.16.e–h, 7.17.a–j). Residual cortex on one or both sides of many bifacial knives and bifacial knife fragments suggests these artifacts often started out as tabular flint nodules or as large cortical flakes. Larger bifacial knives are often lanceolate with straight or

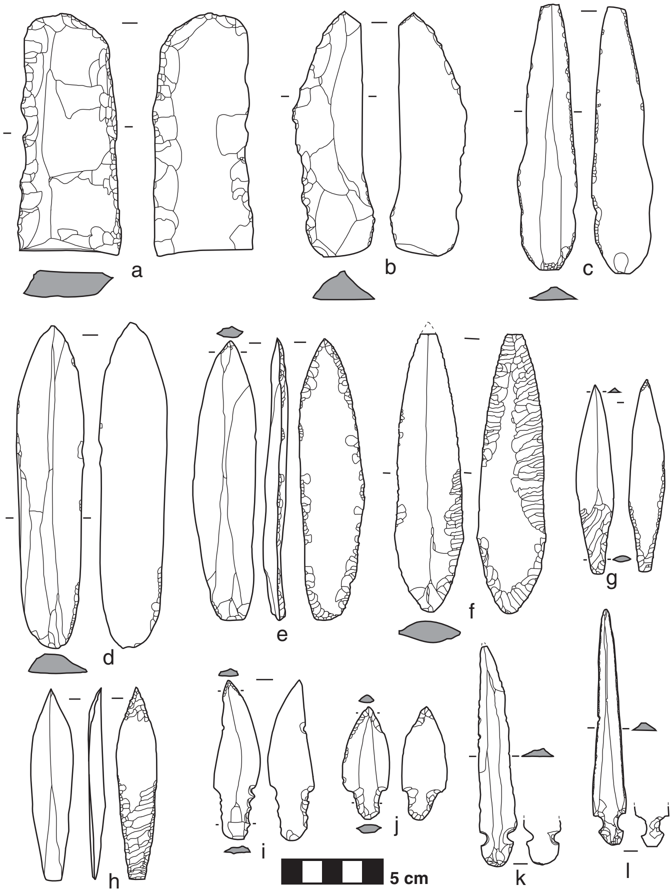


FIGURE 7.16. Neolithic knives on blades. a. bifacially backed blade (Beit Tamir knife), b. unifacially-backed blade, c–d. blades with marginal retouch, e–h. blades with distal and/or proximal retouch, i–j. tanged pieces, k–l. side-notched blades (Nahal Hemar knives). Sources: Beidha (a–d), Byblos (f), Mureybit (e, g–j), Nahal Hemar (k–l). Redrawn after Bar-Yosef and Alon (1988), Cauvin (1968), Cauvin and Abbès (2008), Mortensen (1970).

convex lateral edges and a pointed distal end. Fragments of lanceolate knives are often heavily retouched, even after breakage, suggesting they were highly curated components of Neolithic toolkits. Not all bifacial knives are invasively retouched, however. "Ashkelon knives" (Figure 7.17.f–h) are tabular pieces of flint, rectangular in plan view with noninvasive bifacial retouch (Dag 2008b). Among nearly all of these knife types, one finds evidence of invasive parallel flake scars, likely from pressure-flaking, that attest to enormous outlays of effort in tool production that result in little or no measurable effect on tool functional efficiency. This aspect of Neolithic knife overdesign suggests these artifacts had a significant symbolic function for their users.

It is not clear if there are either strong geographic or chronological trends in Neolithic knife design. Knives made on long pointed blades are mainly found in PPNB contexts, but, other than this, most named Neolithic knife types have either local or, at best, subregional distributions.

Sickle Inserts

Neolithic sickle inserts differ from their Epipaleolithic counterparts mainly in being more extensively modified and more heavily worn from use (Cauvin 1983). There is also clearer typological patterning among them. Most Neolithic sickle inserts can be assigned to one or another of the twelve types (six based on blades, six on flakes/flake fragments) that are listed in Table 7.6. In practice, however, most typologies recognize fewer types. There is not any single, consistently utilized set of names for various kinds of sickle inserts. To minimize the repetition of long type-names, this discussion divides sickle inserts made on blades (or largely complete blade fragments) (Figure 7.18) from those made on flakes or flake/blade fragments (Figure 7.19), enumerating them by Latin capital letters and subdividing these by Arabic numerals.

Unretouched blades and flakes featuring sickle polish (A1 and B1) are rare among Neolithic sickle inserts. Many sickle inserts have some kind of backing, usually steep unifacial retouch, along one lateral edge and/or one or more truncations at distal and/or proximal ends, but there is wide variability. Bifacially backed sickle inserts (B3), sometimes called "Beit Tamir knives," regardless of whether or not they are polished from use, feature moderately invasive retouch on both dorsal and ventral edges of the lateral edge opposite the use-worn dge.

Polished blades with basal modification (A6) usually have one or more concentrations of retouch or burin scars around their base from the removal of the striking platform and/or bulb of percussion. This kind of modification is thought to be an aid to hafting. On some

Table 7.6. *Neolithic Sickle Insert Types*

Major Neolithic Sickle Insert Types	Minor Types
A. Made on blades.	A1. Polished unretouched blade.
	A2. Polished straight-backed blade.
	A3. Blade with small-scale denticulation on polished edge.
	A4. Blade with large-scale denticulation on polished edge.
	A5. Polished blade with basal modification or a retouched tang.
	A6. Blade with two polished lateral edges.
B. Made from flakes or flake/blade fragments	B1. Polished unretouched flake.
	B2. Polished piece with backed edge.
	B3. Polished piece with bifacial-backing (Beit Tamir knife).
	B4. Polished piece with large-scale denticulation.
	B5. Polished piece with flat invasive retouch.
	B6. Polished piece with a curved back.

pieces, the goal of this modification seems to have been to create a sturdy tang that could be fitted into a socketed handle (rather than a slotted handle).

Blades with two polished retouched edges (A7) are sometimes called "Cayonü knives," particularly if the polished edges are retouched. It should be noted, however, that many Cayonü knives are not polished from use as sickles.

There are two main kinds of sickles with denticulated and polished edges. Blades with small-scale denticulation (A3) feature a continuous series of small (1–2 mm wide denticulations). Pieces with large-scale denticulation (A4) are usually short truncated blades with a series of distinct concavities 2–4 mm in width along one edge. The other edge may be retouched, backed, or denticulated as well.

On pieces with flat invasive retouch (B5), retouch scars occur in multiple "generations," suggesting an initial application of invasive

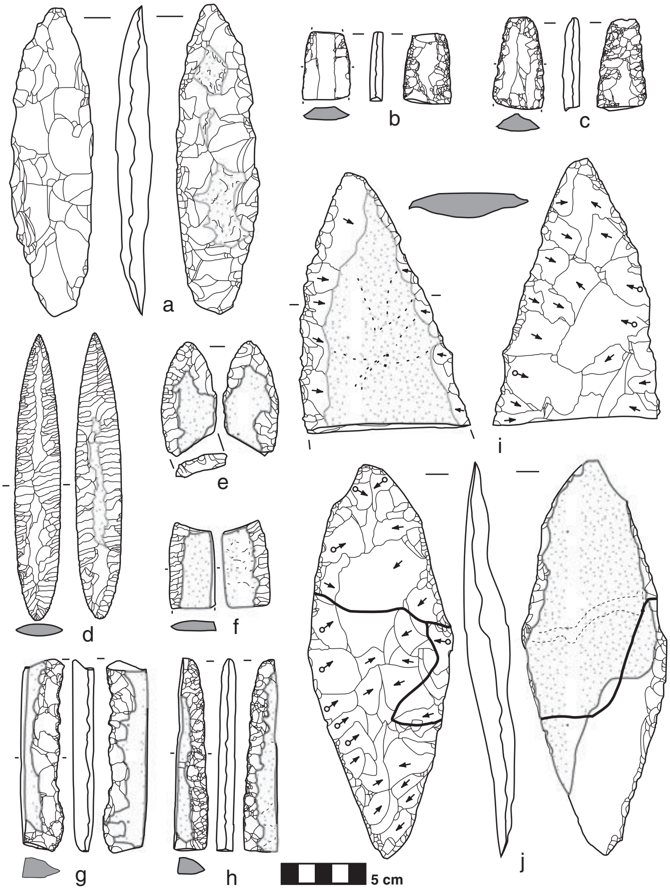


FIGURE 7.17. Neolithic knives on cortical pieces, knife fragments. a. foliate biface finished by percussion, b–c. knife fragments, d. foliate biface finished by parallel-oblique retouch (pressure flaking?), e. pointed knife on tabular piece, f–h. knives on rectangular cortical pieces (Ashkelon knives), i–j. knives on cortical pieces broken during production. Sources Ashkelon (b–c, g–h) Byblos, (d), Har Qeren (a, j), Shar Hagolan (e–f). Redrawn after Alperson and Garfinkel (2002), Cauvin (1968), Dag (2008b), Goring-Morris et al. (1994).

pressure flaking or careful soft-hammer percussion followed by less-invasive retouch to control the shape of the tool.

Pieces with a curved back (B6) are often not fully backed, but instead curved by the imposition of oblique truncations from distal and proximal ends of the piece that do not quite meet up with one another.

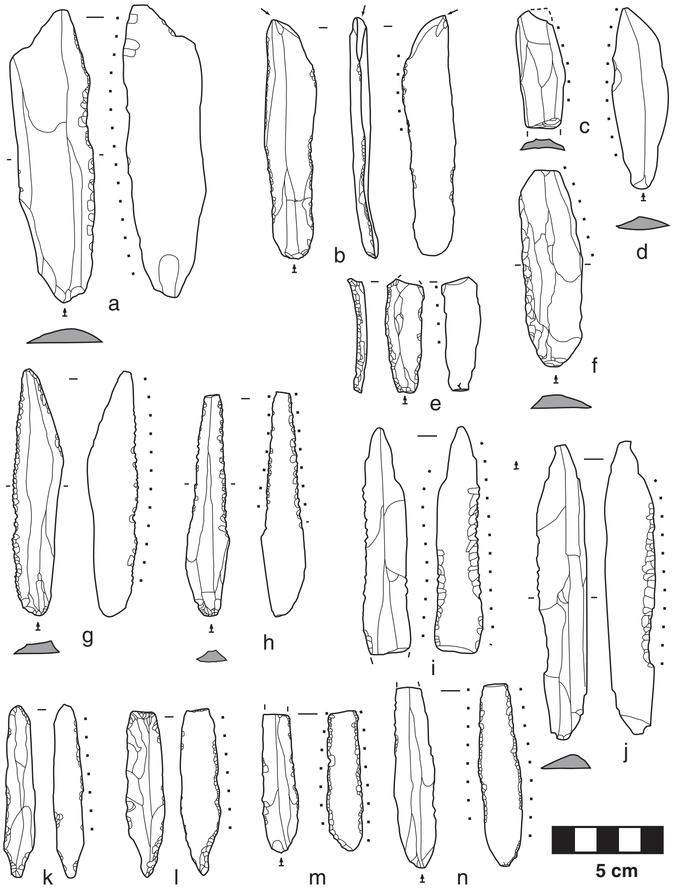


FIGURE 7.18. Neolithic sickle inserts on blades. a–d. polished unretouched blades (A1), e–f. polished straight-backed blade (A2), g–h. blade with small-scale denticulation on polished edge (A3), i–j. blade with large-scale denticulation on polished edge (A4), k–l. polished blade with basal modification or a retouched tang (A5), m–n. blade with two polished lateral edges (A6). Sources: ʻAin Ghazal (m–n), Beidha (a), El Kowm 2 (b), Netiv Hagdud (c–d, f), Aswad (g–h), Munhata (i–j), Mureybit (k), Erq el-Ahmar (l). Redrawn after: Cauvin (1983), Enoch-Shiloh and Bar-Yosef (1997), Mortensen (1970), Nadel (1997), Olszewski (1994), Rosen (1997).

Sickle inserts are thought to have been inserted lengthwise, singly, or in a series, in a slot aligned parallel or obliquely to the handle of the sickle. Longer sickle inserts with a tang or other basal modification might have been inserted into a socket aligned at a steep angle to the long axis of the sickle. CUP Website Figure 42 illustrates some of the

Table 7.7. *Chronological Variation Among Sickle Insert.*

Neolithic Sickle Types	PPNA	PPNB/C	Late Neolithic
A1. Unretouched polished blade	+		
A2. Polished straight-backed blade	+		
B3. Bifacially backed piece	+		
A3. Blades with small-scale denticulation		+	
A5. Polished blades with basal modification or a retouched tang		+	+
B4. Pieces with large-scale denticulation			+
B5. Pieces with flat invasive retouch			+
B6. Pieces with a curved back			+

hafting arrangements for sickle inserts that have been suggested by archaeological finds and experiments

Sickle insert sizes vary widely within each time period, but the largest are those from PPNB contexts made on blades struck from bidirectional cores. Table 7.7 summarizes chronological variation among Neolithic sickle inserts. Unretouched polished blades, polished straight-backed blades, and bifacially backed pieces mainly occur in PPNA contexts. Polished blades with basal modification are found mainly in PPNB contexts. Blades with small-scale denticulation are found mainly in PPNB contexts, whereas pieces with large-scale denticulation are found mainly in Late Neolithic contexts.

Retouched Flake Tools

Most descriptions of Neolithic retouched tools tabulate scrapers, perforators, burins, backed/truncated pieces, and denticulates/notches; but they differ widely in how they subdivide these morphological artifact categories (Figure 7.20). Some do so technologically, discriminating between tools made from blades and those made from flakes, while others do not. Flakes outnumber blades in most Neolithic assemblages and this pattern is paralleled among retouched tool inventories. As noted previously, blades seem to have been preferentially selected for modification into some sickle inserts and projectile point types, but this pattern is not replicated in most other retouched artifact types.

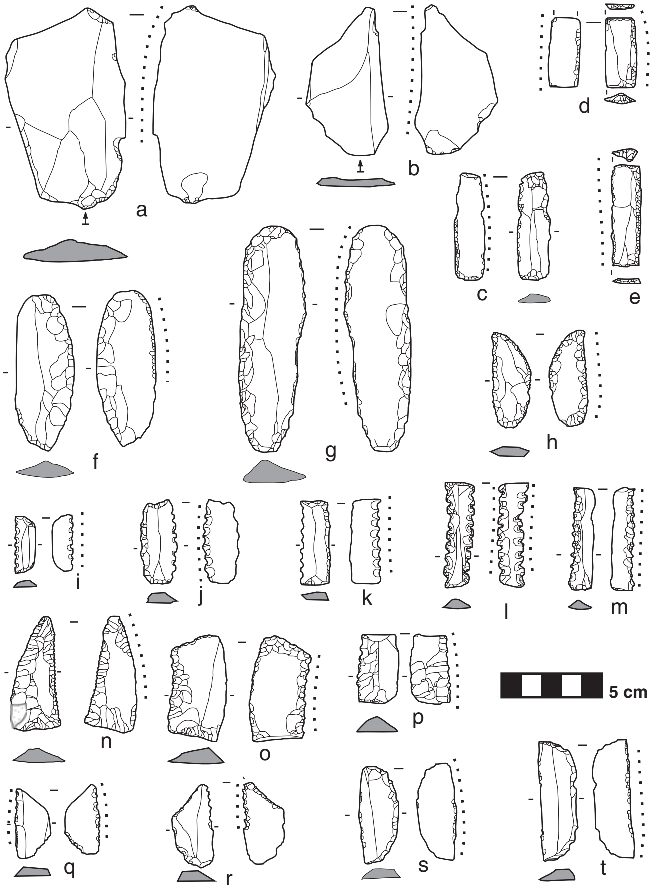


FIGURE 7.19. Neolithic sickle inserts on flakes/flake fragments. a–b. polished unretouched flake (B1), c–e. polished piece with backed edge (B2), f–h. polished piece with bifacial-backing (Beit Tamir knife) (B3), i–m. polished piece with large-scale denticulation (B4), n–p. polished piece with flat invasive retouch (B5), q–t. polished piece with a curved back (B6). Sources: Beidha (a–b), Qatif (c, e), Y–11 (d), Netiv Hagdud (g), Jericho PPNA (f), Qdeir/El Kowm (h, q–r), Ramad II (i–j, o), Byblos (k, s–t), Tel 'Ali (l–m, p), Ramad (n). Redrawn after: Cauvin (1968), Cauvin (1983), Garfinkel (1994), Mortensen (1970), Nadel (1997), Rosen (1997).

The seeming lack of patterning in flake/blade selection gives many Neolithic retouched tool assemblages a kind of "ad hoc" appearance, as if tools were being selected for use and modification on a more or less probabilistic basis, rather than in concordance with any formal set of criteria.

Scrapers

Neolithic assemblages feature a similar range of scraper types to those in Epipaleolithic assemblages. How finely scrapers are subdivided varies widely. Most descriptions recognize single and double endscrapers on blades, scrapers on flakes, and variable numbers of the more-specific scraper types. Tabular/cortical scrapers are a novel Neolithic scraper type (Figure 7.20. a–c). These scrapers are large and relatively flat cortical flakes or flake fragments (rarely blades) with extensive amounts of cortex on their dorsal surfaces. The mode of retouch on their edges varies widely, but it usually creates an acute edge. This suggests some tabular/cortical scrapers may actually have been intended for use as longitudinal cutting tools. Some tabular scrapers have a series of lines incised in their dorsal cortex. It is possible these depressions were intended as aids to hafting or prehension (to prevent the tool from slipping in the hand or handle), but most researchers seem to view them either as incidental tool marks or as serving some symbolic purpose. Some tabular/cortical scrapers have invasive thinning retouch on their dorsal surface, but this is more common among Chalcolithic and Bronze Age artifacts.

Perforators

Among piercing tools, Neolithic typologies often discriminate between awls, elongated perforators, borers, and drill bits (Figure 7.20.d–m). As in the typologies of earlier periods, awls are flakes with one or more short, thick projections formed by adjacent retouched concavities. Awls with thicker cross sections are sometimes classified as becs. Neolithic borers are elongated pieces of triangular or quadrihedral cross section formed by steeply retouched lateral edges. The tips of many borers are rounded from retouch and/or use. (In older literature, the French term, *mèche de foret*, is often used for these artifacts.) Drill bits are long narrow pieces, heavily retouched, and often featuring heavy abrasion from rotary drilling. The specific nature of the materials being pierced by perforators and drill bits remains a matter of conjecture, but tool-marks from rotary drilling occur on bone and stone beads and other artifacts in many Neolithic contexts. Some typologies further distinguish as "microperforators" or *épines* (spines) – awls, borers, or drill bits that have relatively small triangular points knapped on their edges.

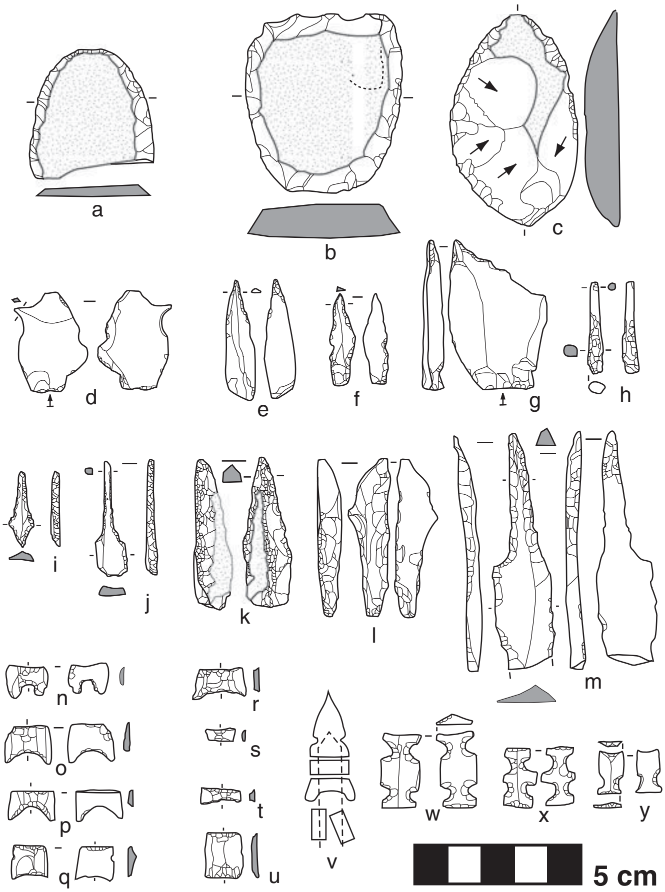


FIGURE 7.20. Neolithic retouched flake tools. a–c. tabular/cortical scrapers, d–g. awls, h. drill bit, i. microperforator, j–m borers, n–u Hagdud truncations, v. conjectural hafting of Hagdud truncations with El Khiam point, w–y. Gilgal truncations. Sources: Byblos (a–c), Gilgal (w–y), Mezraa Teleilat (h–j), Nahal Issaron (l–m), Netiv Hagdud (n–u), Shar Hagolan (e–f, k). Redrawn after Cauvin (1968), Coskunsu (2007), Gopher et al., (1994), Nadel (1997), Noy (1994).

Burins

When they are subdivided, Neolithic burins are usually described in terms of the single, double, dihedral, and multiple burin types. Single burins may be further subdivided in terms of whether they are simple transverse burins on a natural break or on a truncation. Burins on blades that feature sickle polish would usually be classified as a form of sickle insert.

Notched/Denticulated Pieces

Denticulate tools other than sickle inserts in Neolithic assemblages are often simply lumped together into denticulates, notches, or some combined taxon. More exhaustive descriptions often discriminate between single notches, double notches, multiple notches, and denticulates. Other descriptions may further differentiate these artifacts on the basis of whether they occur on blades, flakes, or flake fragments.

Backed/Truncated Pieces

Descriptions of backed and/or truncated pieces in Neolithic assemblages often distinguish between tools made from blades and those made either on flakes or on indeterminate sources. Again, this seems more a matter of habit, of thinking of blades as somehow worthy of special distinction, rather than something justified by prior theory.

Hagdud truncations are blade segments that have been truncated and/or notched at their distal and proximal ends (Nadel 1994) (Figure 7.20.n–u). Found mainly in PPNA contexts, Hagdud truncations are very small, often less than 10 mm long. They were almost certainly components of hafted tools. Nadel has conjectured that Hagdud truncations were fitted into slots cut into the ends of arrow shafts to lengthen the weapon's lithic cutting edge while preserving the flexibility of the wooden shaft (Figure 7.20.v).

The Gilgal truncation is a kind of combination denticulate and truncation (Noy 1994). These artifacts are medial fragments of blades with truncations at one or both ends and two or more notches (Figure 7.20.w–y).

Multiple Tools and Varia

As among earlier periods, Neolithic typologies include classifications for tools that combine more than one morphologically distinct retouched edge type, such as scraper-perforator, burin-denticulate, and the like, as well as an unclassifiable residual of idiosyncratic and unique artifacts ("varia").

IV. NEOLITHIC GROUNDSTONE

Collectively, Levantine Neolithic contexts provide a wide variety of ground and carved stone artifacts. These artifacts are relatively rare

Table 7.8. *Major Categories and Types of Neolithic Groundstone Artifacts*

Tool Category	Major Types
Groundstone celts/axes	Oval thick polished bifacial celt/axe
	Triangular polished bifacial celt/axe
	Polished bifacial celt/axe with rectangular section.
	Pedunculated polished celt/axe
	Elongated/chisel-like celt/axe
	Perforated celt
	Miniature polished celt ('herminette")
Pulverizing equipment	Grinding Slab/quern
	Mortar
	Bedrock mortar
	Handstone
	Pitted handstone
	Pestle (cylindrical, conical, bell-shaped)
	Polishing stone/pebble
Carved stones	Concave stone
	Grooved stone
	Incised stone
Perforated stones	Symmetrical perforated stone
	Asymmetrical perforated stone
	Pendant palette
Stone vessels	Platter
	Bowl
	Vessel with shaped base
	Miniature vessels

compared to flaked stone tools, and as a consequence the conventions used to describe groundstone artifacts vary widely among researchers. Of the various frameworks used to describe groundstone tools, Wright's (1992) typology is the most systematic. Neolithic groundstone tool types are discussed here in terms of four major groups of artifacts: celts/axes, pulverizing equipment, carved stones, and vessels (Table 7.8). Other kinds of lithic artifacts, such as beads, statues, monumental architecture, and other non-mechanical/utilitarian artifacts, while important for Neolithic prehistory, lie beyond the scope of this work.

Groundstone Celts/Axes

Groundstone celts are less often typologically subdivided than flaked-stone celts. Often, they are simply described as "celts," "axes," or "celts/axes." Most typological distinctions among groundstone celts/axes focus on their shape in plan or cross section view, rather than the shape of their edges. Kozlowski and Aurenche (2005) recognize four major groundstone celt/axe types (Figure 7.21). The first three (oval thick polished bifacial celts, triangular polished bifacial celts, and polished bifacial celts with rectangular sections) are found throughout the Levant. A fourth type, pedunculated polished celts, is known mainly from sites in Anatolia. Somewhat less common are elongated, chisel-like axes and perforated axes. As among flaked-stone celts, many assemblages feature miniature versions of groundstone celts (*herminettes*) of various shapes.

Pulverizing Equipment

Neolithic pulverizing equipment includes querns/grinding slabs, mortars, handstones, pestles, pounders, polishing pebbles, and worked pebble/cobbles. Figures 7.22 and 7.23 show examples of Neolithic pulverizing equipment.

A quern/grinding slab is the lower, stationary part of a pair of grinding stones. These artifacts usually have a flat or moderately convex base and an upper working surface with use-related concavities. Grinding slabs show evidence (in the form of polish and striations) for linear movements (Figure 7.22.a–e), whereas querns have working surfaces worn from rotary abrasion (Figure 7.22.f–i). In many instances, grinding slabs have hemispherical depressions ("cup-marks") on their working surfaces, suggesting they were re-purposed as either querns or mortars (Figure 7.22.l–m).

Mortars are the lower, stationary parts of pairs of tools used for pounding and vertical rotary grinding on the side walls of the mortar's working surface. These working surfaces are usually round in plan view and either hemispherical or deeply concave in profile (Figure 7.22.k). In many cases, mortar use appears to have continued after prolonged use created a perforation at the bottom of these working surfaces. Ethnographic examples of similar such perforated mortars

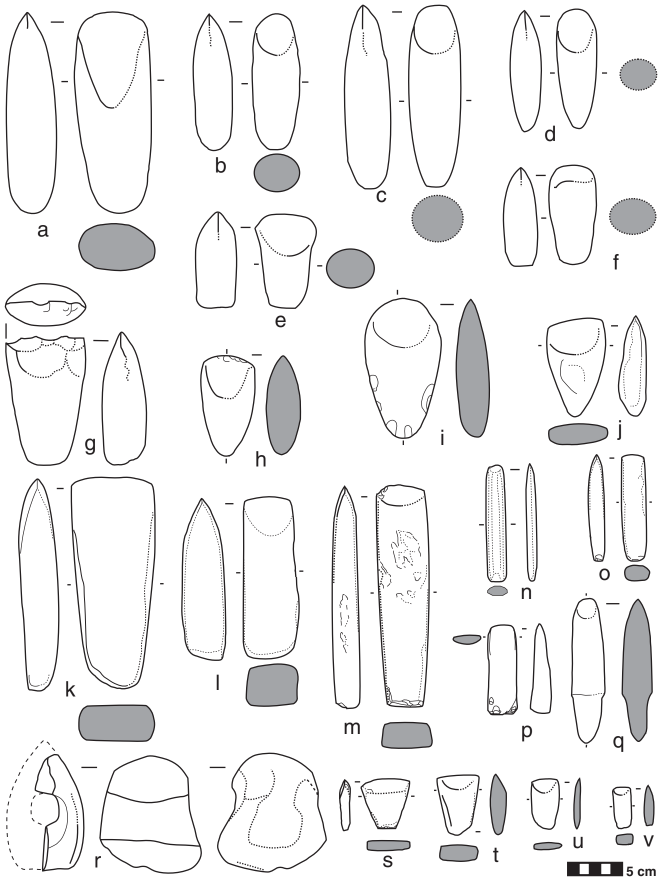


FIGURE 7.21. Neolithic groundstone celts/axes. a–f. oval thick bifacial polished celts/axes, g–j. triangular polished bifacial celts/axes, k–m. polished bifacial celt/axe with rectangular section, n–p. elongated chisel-like celts/axes, q. pedunculated polished celt/axe, r. perforated polished celt/axe fragment, s–v. miniature polished celt/axes ("herminettes"). Sources: Beidha (b), Bouqras (a, j–p, s–v), Çayönü (h), Jericho (c–g, r), Hallan Çemi (q), Nemrik (i). Redrawn after Dorrell (1983), Kozlowski and Aurenche (2005).

suggest their use-lives may have been prolonged by attaching them to a wooden board so that the walls of the concavity could continue to be used.

Bedrock mortars (see Chapter 6), which are relatively common in later Epipaleolithic contexts, are less common in Neolithic contexts (Eitam 2009). In part, this may reflect decreased use of cave/rockshelter

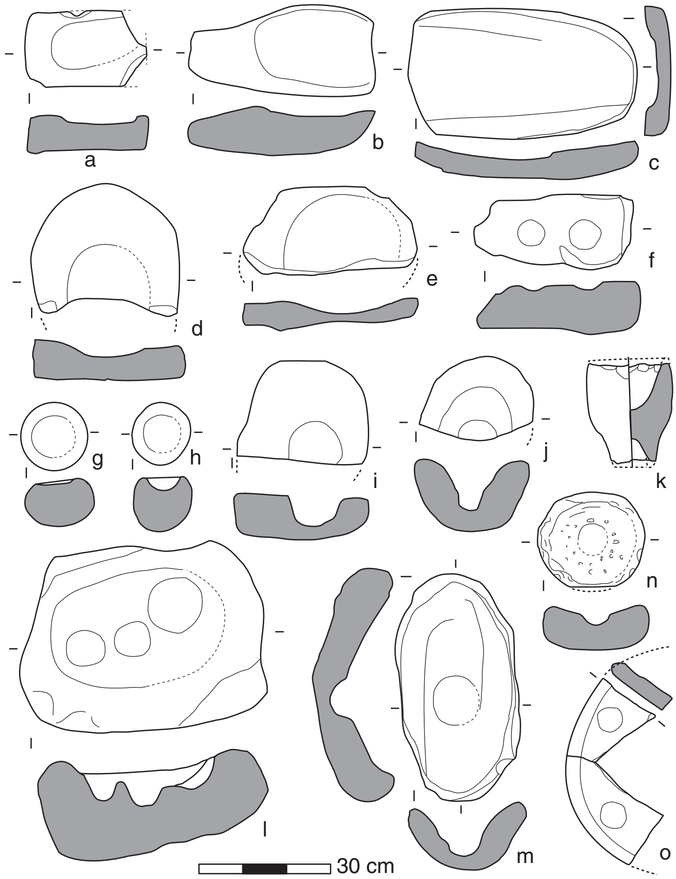


FIGURE 7.22. Neolithic pulverizing tools (1 of 2). a–c. grinding slabs, d–e. querns, f–h. shallow mortars, i–k. deep mortars, l–o. combination grinding slabs, querns, mortars. Sources: Besiamoun (h, k), Netiv Hagdud (a, d–f, l, n), Munhata (g), Mureybit (b–c, i–j, m, o). Redrawn after Gopher (1997), Kozlowski and Aurenche (2005), Nierlé (2008).

sites as Neolithic residential sites. Bedrock outcroppings are less common on the alluvial fans, as are other landforms on which Neolithic groups built larger habitation sites.

Neolithic sites occasionally preserve evidence for querns/grinding slabs whose working surfaces also feature circular depressions from use as mortars. These artifacts may reflect either the recycling of querns/grinding slabs as mortars or some other kind of combination pulverizing tool.

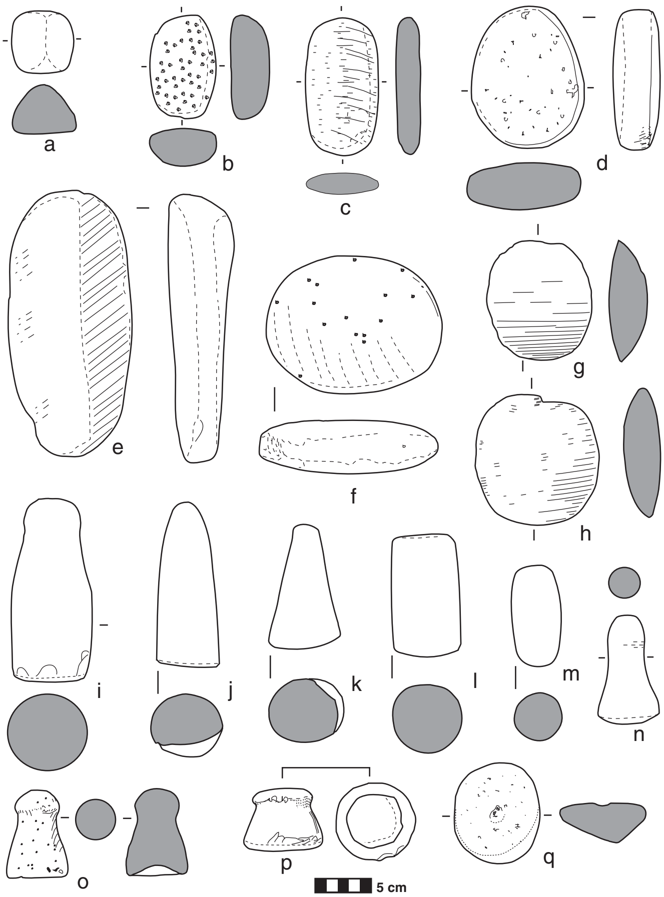


FIGURE 7.23. Neolithic pulverizing tools (2 of 2). a–h. handstones, i–p. pestles, q. pitted handstone. Sources: Beidha (d–f, i, o–p), Jericho (g–h, j–n), Netiv Hagdud (a–c, q). Redrawn after Dorrell (1983), Gopher (1997), Kirkbride (1966).

Handstones are the mobile counterpart to querns/grinding slabs (Figure 7.23.a–h). These tools feature evidence of abrasion (polishing, striations) over a substantial part of their surface. They are distinguished from pestles by having their working surface(s) aligned more or less in parallel with their long axis. As a typological category, handstones are highly variable. The may have one, two, or more distinct abraded surfaces. They may be round, oval, sub-rectangular, tabular, or plano-convex in either plan or section. Handstones from PPNB and later contexts often feature sharp edges formed by the intersection of abrasion surfaces (Figure 7.23.g–h). This development parallels increased use of bidirectional (as opposed to rotary) abrasion on querns and grinding slabs. Some researchers recognize as distinct a subset of handstones with round pitted concavities one or more of their surfaces.

Pestles are the mobile pounding tools used with mortars (Figure 7.23.i–p). They are typically elongated with their working surfaces located at one or both ends. Many pestles are round in cross section and more or less symmetrical in profile. Many researchers further subdivide pestles typologically into cylindrical, conical, and bell-shaped variants, the latter having a bulbar knob at their distal end. These distinctions, however, do not appear to have clear chronological or geographic patterning, nor do they scale along with artifact size.

Polishing stones are abraded pieces of flint or quartzite, with bright, artificially polished surfaces (Figure 7.24.a–c). These artifacts are frequently made on water-abraded clasts (and sometimes called "polishing pebbles"). Similar stones are used by ethnographic potters to burnish ceramic vessels prior to firing and by hide-workers to smooth the surface of tanned leather.

Wright's (1992) typology of groundstone tools recognizes two additional types: pounders and worked pebbles/cobbles. Pounders are ad-hoc hammerstones made on cores or other flintknapping products. Worked pebbles/cobbles are hammerstones on clasts.

Carved Stones

Carved stones are clasts or slabs that have been modified by incision or perforation, but which retain detectable amounts of their original unmodified form. These comprise mainly carved stones and perforated stones.

Concave stones are clasts with one or more (often two) shallow concavities carved into them (Figure 7.24.d–e). When two concavities are present, they are often directly opposite one another. On some specimens, carving or use (or both) results in a perforation between the two concavities (Figure 7.24.d). The functions of these artifacts remain an enigma.

Grooved stones are oval stones into which an elongated concavity has been carved on one or more sides (Figure 7.24.f–g). This concavity

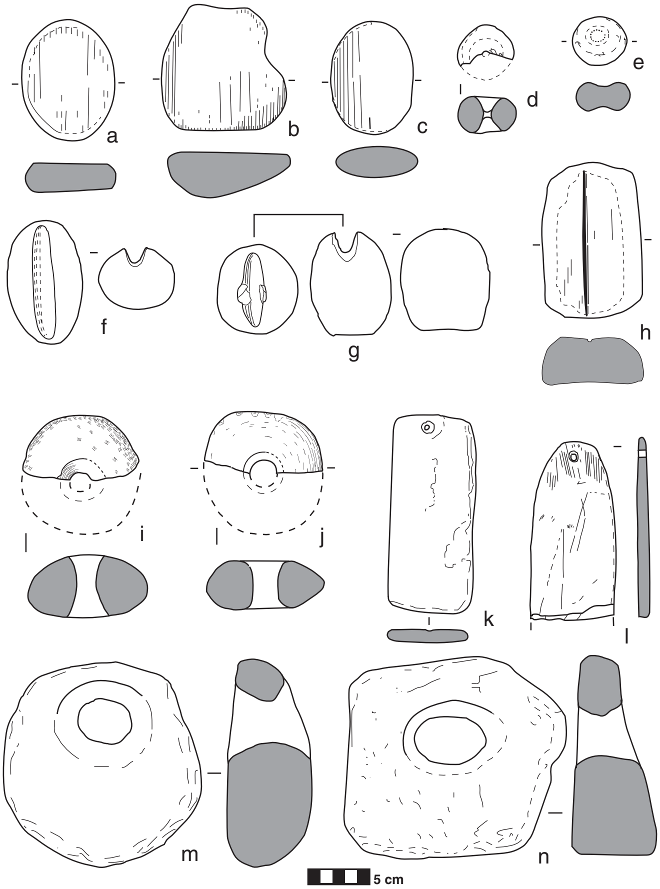


FIGURE 7.24. Neolithic polishing stones and carved stone tools. a–c. polishing stones, d–e. concave stones, f–h. grooved stones, i–j. symmetrical perforated stones, k–l. pendant palettes, m–n. asymmetrical perforated stones. Sources: Beidha (k–n), Jericho (a–d, h–j), Netiv Hagdud (e–g). Redrawn after Dorrell (1983), Gopher (1997), Kirkbride (1966).

has traces of linear abrasion, suggesting its use to smooth the surface of a cylindrical object. These artifacts are sometimes called "shaft straighteners," reflecting the hypothesis that they were used to smooth or shape the shafts of arrows, darts, and spears.

Neolithic assemblages can feature a wide range of artifacts, including both slabs and clasts that feature repetitive scratch marks on their surfaces (Figure 7.24.h, k–l). In some cases, these markings may result from the use of the stone as a surface on which softer materials were cut. In others, the markings are patterned, suggesting some symbolic purpose. The decision of whether to assign an artifact to one or the other of these categories varies among researchers.

Perforated stones occur in a wide range of sizes and shapes. Rounded asymmetric perforated stones (Figure 7.24.m–n) are sometimes interpreted as loom weights, while broad perforated cones are sometimes viewed as spindle whorls. In both cases, these inferences reflect commonplace interpretations of similar artifacts from ethnographic and recent archaeological contexts. Symmetrical perforated stones that are roughly spherical and that feature perforations larger than 1–2 cm in diameter (Figure 7.24.i–j) are sometimes described as "mace-heads." Mace heads are more common in the Chalcolithic and Early Bronze Age, but examples are also known from Middle and Late Neolithic contexts (Rosenberg 2010).

Pendant palettes are relatively small flat stones with a small perforation at one end (Figure 7.24.k–l), presumably to allow it to be suspended on a string. The flat surfaces of these artifacts often feature striations and other abrasive wear suggesting they were used as grinding surfaces. These surfaces were too small for food processing, and, as their name suggests, were probably used to prepare pigments or some other substance in small quantities.

Perforated discs and fragments of perforated discs occur in many Neolithic contexts. Smaller examples are often interpreted as beads or spindle whorls. Larger examples are sometimes interpreted as grinding stones. Some prehistorians see these larger discs as weapons, flatter versions of mace-heads (see discussion earlier in this section). In Ethiopia, perforated stone discs are used as weights for digging sticks (Waldron 1987). This practice is thought (by archaeologists) to be common elsewhere in Sub-Saharan Africa, but ethnographic documentation is equivocal or lacking (Hromnik 1986).

Stone Vessels

Stone vessels are carved and abraded artifacts featuring a wide or deep concavity. The materials out of which these vessels were made include basalt, limestone, steatite, marble, alabaster, and other rock types. Most descriptions of stone vessels recognize platters, bowls, and vessels with various kinds of shaped bases, and a variety of miscellaneous forms

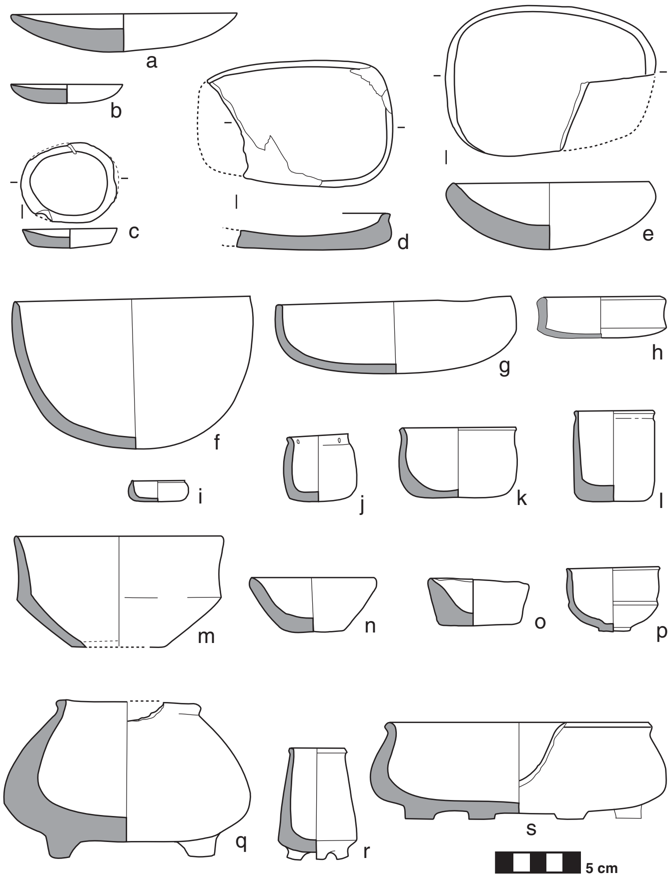


FIGURE 7.25. Neolithic stone vessels. a–e. platters, f–p. bowls, q–s. vessels with shaped bases. Because they are less than 10 cm long, b–c, h–l, n–q would be considered "miniature vessels." Sources: Bouqras (a–m, o–p), Jericho (n). Redrawn after Roodenberg (1986), Wright (1993).

(Figure 7.25). Platters are shallow vessels whose ratios of rim diameter to height is greater than 3.0. Plan view shape varies widely among platters, but round, oval, or sub-rectangular shapes are common. Bowls are distinguished by their hemispherical, conical, or cylindrical concavities and by their lack of modified bases. Vessels with shaped bases are often divided into those with solid bases and those with small projections raising the body of the vessel above the surface on which it would otherwise rest (Kozlowski and Aurenche 2005, Wright 1992). These major types grade into one another. In many cases, particularly when the artifacts are fragments of larger vessels, assignment to one specific vessel type may be impossible. Most analyses distinguish as "miniature vessels" those less than 10 cm in diameter and less than or equal to 10 cm in height. Large or small, platters, bowls, and other stone vessels are often further subdivided on the basis of the shape of their rims and walls, as well as their surface decoration in much the same way as are ceramic artifacts from Neolithic and later periods.

Traces of burning on some stone vessels suggest they were used as culinary aids, while on others, the extent of surface decoration and polishing suggests a significant symbolic component. These two mec hanical and symbolic functions, of course, are not mutually exclusive.

Variation among Neolithic Groundstone Tools

Table 7.9 summarizes the occurrence of various kinds of groundstone tools in Neolithic contexts, as reported by Wright (1993, 1994). About three quarters of all Neolithic sites preserve groundstone tools, and this proportion peaks in Early-Middle PPNB times. The most common Neolithic groundstone tools are handstones (23.4 percent), stone vessels (16.6 percent), and "other" groundstone tools (17.85 percent). PPNB contexts account for the majority of these groundstone tools, however, and it would be wrong to project these modalities more generally. For example, bedrock mortars are common in PPNA contexts, but otherwise rare. Similarly, groundstone celts are common in PPNB contexts, but less common in PPNA and Late Neolithic periods.

Kozlowski and Aurenche (2005) summarize geographic typological variation among Neolithic groundstone tools and vessels. In general, there appears to be a wider range of forms, and more elaborately shaped forms in the northern Levant than in the south. At this point in time, however, it is not clear if this reflects differences in raw material variability, ecogeographic variation in the use of these artifacts, or methodological differences among archaeologists in how these artifacts are described.

IV. NEOLITHIC ASSEMBLAGE-GROUPS/INDUSTRIES

Major Neolithic assemblage-groups and exemplary sites/assemblages are listed in Table 7.10. The chronology, geography, and hypothetical

Table 7.9. *Occurrences of Neolithic Groundstone Tools*

Period (n samples)	n (%) with Groundstone Tools	n (%) of Groundstone Tools	Quern	Handstone	Mortar	Bedrock Mortar	Pestle	Stone Vessel	Grooved Stone	Perforated Stone	Celt	Other
PPNA & Harifian (34)	27 (79.4)	1077 (10.5)	54	259	68	185	291	128	42	2	31	575
Early–Middle PPNB (31)	29 (93.5)	3094 (30.1)	239	501	74	10	57	361	79	76	177	543
Late–Final PPNB (44)	31 (70.5)	4058 (39.5)	122	1195	35	2	133	897	17	73	134	309
Ceramic Neolithic (60)	43 (71.7)	466 (4.5)	42	83	26	1	20	56	21	85	20	118
All Neolithic (169)	130 (76.9)	8695 (100.0)	457 (5.3)	2038 (23.4)	203 (2.3)	198 (2.3)	501 (5.8)	1442 (16.6)	159 (1.8)	236 (2.7)	362 (4.2)	1545 (17.8)

Sources: Wright (1993, 1994).

Table 7.10. *Neolithic Assemblage-Groups and Selected Representative Contexts*

Period and Dates	Assemblage-Groups	Representative Contexts
Early Neolithic (12.2–11.0 Ka)	Khiamian	El Khiam Terrace
		Abu Maadi
		Göbekli Tepe
		Mureybit I B-II A
		Nahal Oren
		Nasharini
		Salibiya IX
		Sheikh Hassan
		Qaramel
	Sultanian	Tel es-Sultan (Jericho) PPNA
		Gilgal I
		Hatula
		Nahal Oren
		Netiv Hagdud
		Salibiya IX
		Dhra'
		Zaharat adh-Dhra'2
		Iraq ed-Dubb
		'Ain Darat
		Wadi Feinan 16
	Aswadian	Tel Aswad
	Mureybitian	Mureybit III A-B
		Sheikh Hassan
		Jerf el Ahmar
		Tel Qaramel
		Çayönü (base and grill)
	Qermezian	Qermez Dere
	Nemrikian	Nemrik 9 Phase V
Middle Neolithic (11.0–8.4 Ka)	PPNB/BAI	Tel es-Sultan (Jericho)
		Abu Ghosh
		Abu Hureyra 2A-B
		Abu Salem
		'Ain Ghazal
		Besiamoun
		Bouqras
		Çayönü I
		El Kowm 2

Period and Dates	Assemblage-Groups	Representative Contexts
		Halula
		Kfar Hahoresh
		Mureybit IV A-B
		Munhata
		Nahal Divshon (SMU D1)
		Qdeir
		Ramad I-II
		Ras Shamra VB-C
	PPNC	Atlit Yam
		Ain Ghazal
		Ashkelon
Late Neolithic (8.4–6.5 Ka)	Yarmukian	Shar Hagolan
		Ashkelon
		Ain Ghazal
		Munhata
		Ein Rahub
		Nahal Qanah Cave
	Jericho IX	Tel es-Sultan (Jericho) Level IX
		Ein el Jarba
		Givat Haparsa
		Nizzanim
		Teluliot Batashi
	Wadi Rabah	Teluliot Batashi
		Tel es-Sultan (Jericho) Level VIII
		Bethshean Level XVII
		Nahal Zehora I and II
		Munhata Level 2A
		Tel Ali
	Tuwailian	Tell Tuwail
		Hamifgash 2
		Har Qeren
		Qadesh Barnea
	Qatifian	Qatif
		Tell Wadi Feinan
		Teluliot Batashi
	Besorian	Nahal Besor/Wadi Ghazzeh Site D
		Ramat Nof

(*continued*)

Table 7.10 (*continued*)

Period and Dates	Assemblage-Groups	Representative Contexts
		Ramot 3
		Teleilat Ghassul Phase 1
	Pre-Halafian	Tel Sabi Abyad Levels 4–11
	(Late BAI)	Tel el Kerkh Rouj 2c
		Tel Halula III-IV
		Tel Hassuna I-III
	Agro-Standard	Ras Shamra VB (Amuq A-B)
		Tel el Kerkh Rouj 2d
		Tel Halaf I (Proto-Halafian)

relationships among these assemblage-groups are complex and controversial. This complexity reflects the fact that categories of material culture other than lithics (such as ceramics and architecture) play a more significant role in Neolithic assemblage-group systematics. Ceramics and architecture are thought to be more sensitive registers of cultural relationships than are lithics. Consequently, taxonomic distinctions among Neolithic assemblage groups, or "cultures," can conceal underlying similarities among the associated lithic evidence. This problem is more pronounced in later Middle Neolithic and Late Neolithic contexts than it is in Early Neolithic contexts. One of the main problems one faces for the Late Neolithic is that lithic assemblages for keystone sites are either undescribed or characterized only superficially. The following descriptions of Neolithic assemblage-groups mainly follow Aurenche and Kozlowski (1999), Bar-Yosef (1995), Cauvin (2000), Gopher and Gophna (1993), Kozlowski (1999) and Kozlowski and Aurenche (2005).

Early Neolithic (12.2–11.8 Ka ca. BP)

Named Early Neolithic industries/assemblage-groups include the Khiamian, Sultanian, Aswadian, and Early Mureybitian. (Harifian assemblages are discussed in Chapter 6.) Collectively, these assemblages differ from preceding Later Epipaleolithic assemblages in showing a

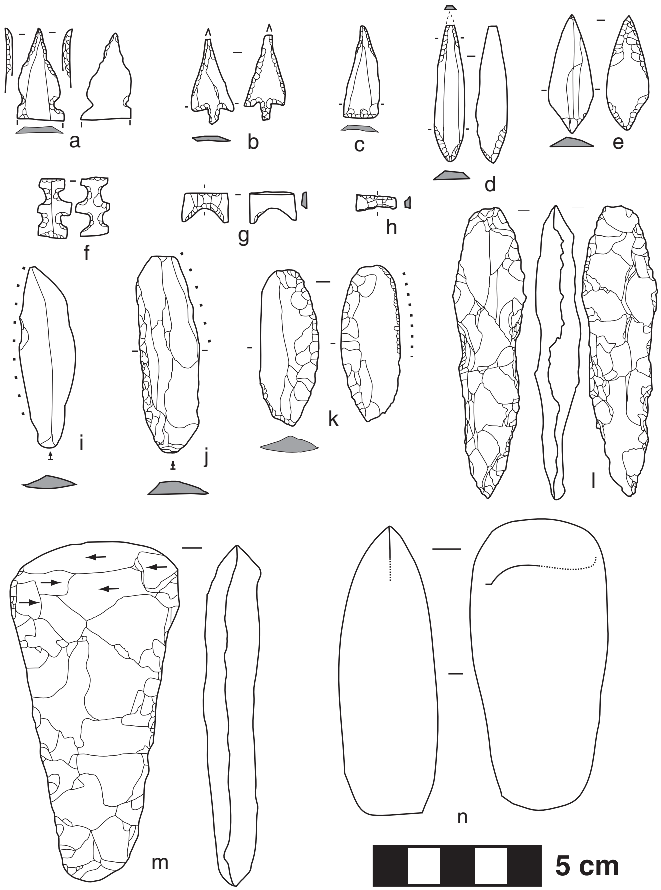


FIGURE 7.26. Early Neolithic artifacts. a. El Khiam point b. Jordan Valley point, c. Salibiya point, d. Nemrik point, e. Abu Maadi point, f. Gilgal truncation, g–h. Hagdud truncations, i–k. sickle inserts i. polished unretouched blade, j. polished straight-backed blade, k. polished piece with bifacial-backing), l. bifacial celt (chisel), m. bifacial celt (axe) with tranchet retouch, n. groundstone celt/axe. Sources: Abu Maadi I (d), Gilgal I (f), Nemrik 9 (e), Netiv Hagdud (a–c, g–l). Redrawn after Gopher (1994), Kozlowski (1999), Nadel (1997), Noy (1994).

greater emphasis on blade/bladelet production. Figure 7.26 shows exemplary Early Neolithic artifact-types.

The Khiamian was first recognized by excavations at el-Khiam Terrace. Subsequently, other occurrences have been identified across the length of the Levant, from Abu Maadi in the Sinai to Mureybit in the Euphrates Valley and east at Azraq Oasis. Notched El-Khiam points are the diagnostic lithic artifacts of the Khiamian, but crescents and other geometric microliths co-occur with El Khiam points in many contests. In the northern Levant, Nevali Çori and Qaramel points occur as well. Khiamian assemblages also contain backed bladelets, blade segments, polished endscrapers, and various kinds of perforators, including micro-perforators. Small flaked stone celts (*herminettes*) occur in some Khiamian contexts (e.g., Mureybit). Sickle inserts take the form of large blades with minimal retouch. Groundstone artifacts are relatively uncommon. Most researchers view Khiamian assemblages as reflecting a continuation of hunting and gathering adaptations. Most Khiamian contexts date to between 12.2 and 11.8 Ka cal. BP.

Sultanian assemblages were first identified at Tel es-Sultan (Jericho). They have since been identified mainly in the Central Levant. Most dated Sultanian contexts range between 11.6 and 11.0 Ka cal. BP. El Khiam points occur in Sultanian assemblages, but they are relatively uncommon. Geometric microliths are rare or absent. Blade/bladelet production involves both unidirectional and bidirectional modes of core reduction. Bifacial backing of blades and other tools ("Beit Tamir knives") suggests continuities with Natufian bifacial Helwan retouch. Apart from the Beit Tamir knives, some of which feature sickle polish, sickle inserts appear mainly as large blades with minimal retouch. Hagdud truncations are common. Unlike in the northern Levant, flaked stone celts (axes, adzes, and chisels) are common. In many cases, these flaked stone celts are resharpened by tranchet blows. Small quantities of obsidian appear at most sites. Grinding slabs and querns are common, and groundstone celts/axes occur as well. The reduced frequencies of El Khiam points and the increased frequencies of celts (both flaked and groundstone) and groundstone pulverizing equipment point to the Sultanian as reflecting more sedentary agriculture-dependent adaptations.

The Aswadian industry was proposed by De Contensen (1989) on the basis of excavations at Tel Aswad in Syria. Many of the Aswadian's key characteristics are essentially those seen among Middle Neolithic PPNB assemblages. These include bidirectional naviform blade core technology, Helwan points (including the local variant of this type, the Aswad point), and reaping knives made on long blades with denticulated edges and retouched bases. Such quintessentially Sultanian tool types as geometric microliths, Hagdud truncations, and flaked stone celts with tranchet resharpening are absent. Although there are some parallels with Mureybit III, the Aswadian is thus far known mainly from Tel Aswad itself. With this limited evidence, a series of small (2–3 m diameter) circular huts and what appear to be storage pits, the picture of Aswadian adaptations parallels the Sultanian adaptation – sedentary hunter-gatherers practicing small-scale agriculture.

The Mureybitian industry was recognized on the basis of excavations at Tel Mureybit in Syria, and has subsequently been found at other localities primarily in the northern Levant. Like the Aswadian, Mureybitian assemblages feature naviform blade cores, sickle inserts made on long micro-denticulated, and tanged blades. Among projectile points, notched Helwan points are common early on, but over time these are augmented and eclipsed by Byblos and Amuq points. Larger versions of these points are usually classified as knives or spear points together with large pointed blades that feature minimal retouch. Some projectile points and knives are made of obsidian. Scrapers are common, as are denticulates, but burins are rare in earlier contexts and more common in later ones. Celts include tanged and broad-bladed forms made on large flakes whose working edges are shaped by careful unifacial retouch. Groundstone celts/axes also occur, and there is a diverse array of groundstone pulverizing equipment. Such "Sultanian" elements as geometric microliths, Hagdud truncations, and tranchet celts are also rare or absent. In all of these respects, the Mureybitian prefigures key features of PPNB lithic assemblages from Middle Neolithic times in both the northern and southern Levant.

In the northern reaches of the Tigris and Euphrates rivers, the periods equivalent to the Later Epipaleolithic and Early Neolithic witness the deposition of Qermezian assemblages (after Qermez Dere). These feature El Khiam points and a lithic assemblage similar to Khiamian assemblages in the Levant. Its distinctive features include long, symmetrical perforators, broad "fan-shaped" scrapers, triangular geometric microliths, and endscrapers made on narrow blades. In these respects, Qermezian assemblages seem to retain stronger affinities to their local Epipaleolithic Zarzian predecessors. The Qermezian is succeeded by a Nemrikian industry. El Khiam points are present, but the signature artifacts are rhomboidal Nemrik points and various tanged points. Retouched blades (including sickle inserts) are the most common retouched tools, and perforators and endscrapers are common. Nemrikian assemblages also contain grinding slabs, mortars, celts/axes, perforated stones ("mace heads"), stone balls, and stone vessels. The Nemrikian persists into Middle Neolithic times, where it is followed by a regional variant of the PPNB (see discussion later in the next section).

In much of the southern Levant, there is a gap between the youngest occurrences of the Early Neolithic Sultanian/PPNA assemblages and early Middle Neolithic PPNB assemblages. In the northern Levant, the break between Early and Middle Neolithic entities is less obvious. Many Levantine prehistorians see the origins of PPNB assemblages among northern Levantine Early Neolithic entities, particularly the Mureybitian and the Aswadian. Kozlowski and Gebel (1994) take this one step further and refers to both industries collectively as "Early PPNB."

Middle Neolithic (11.0–8.5 Ka cal. BP)

The defining characteristics of Middle Neolithic lithic assemblages include unidirectional and bidirectional naviform blade core reduction, Helwan points, and Elongated points (Jericho, Byblos, and Amuq points) made on large blades. Sickle inserts are also made on long blades, and often feature basal modification for hafting and/or small-scale denticulation of their working edge or edges. Points and sometimes sickle blades are often covered by invasive parallel flakes that are generally attributed to pressure flaking. Pressure-flaking is also seen as a factor in the creation of conical "bullet-shaped" cores of both flint and obsidian. Edge-grinding and polishing replace the practice of resharpening flaked stone axes by tranchet removals. Groundstone celts/axes become more common, and there is a general increase in all categories of groundstone tools. Among groundstone pulverizing equipment, querns worn from bidirectional motion begin to replace grinding slabs worn from rotary motion. Obsidian becomes more common outside of its source areas in the Taurus-Zagros range. Figure 7.27 shows examples of characteristically Middle Neolithic artifact-types.

Although the Middle Neolithic Period is known throughout much of the Levant as the PPNB, there are significant divisions in how lithic assemblages dating to this period are organized.

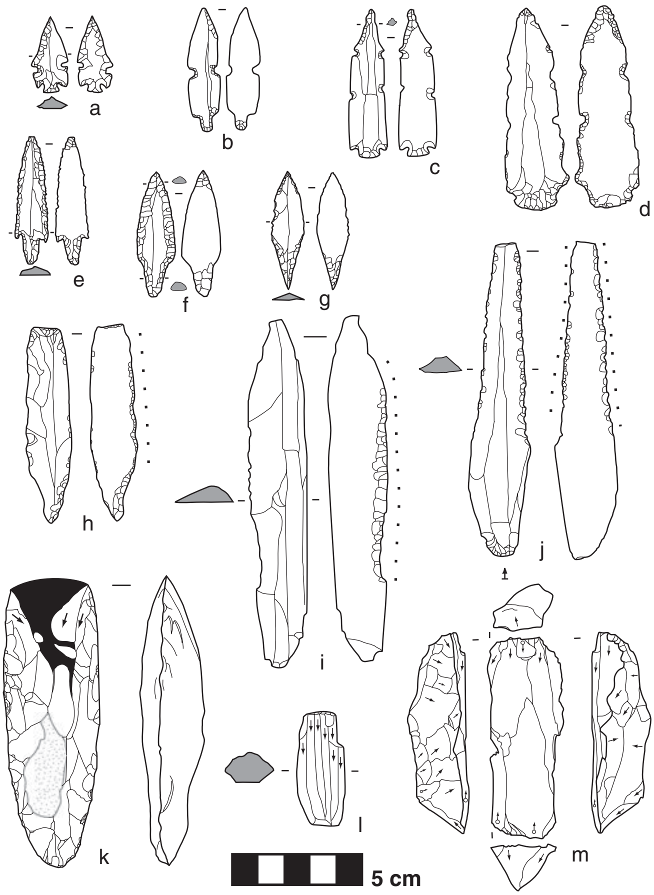


FIGURE 7.27. Middle Neolithic artifacts. a–d: Helwan points (a. Abu Salem point, b. Sheikh Hassan point, c. Aswad point, d. large Helwan point), e–g. elongated points (e. Jericho point, f. Byblos point, g. Amuq point), h–j. sickle inserts (h. polished blade with basal modification or a retouched tang, i. blade with small-scale denticulation on polished edge, j. blade with two polished lateral edges), k. bifacial celt (adze) with polished edge, l. bullet-shaped core, m. bidirectional naviform blade core. Sources: Abu Salem (a, e), Aswad 1 (c, j), Bouqras (l), Byblos (f, k), Erq el-Ahmar (h), Munhata (i), Mureybit (b, j), Nahal Issaron (g), Nahal Oren (d), Sheikh Hassan (m). Redrawn after Abbes (2003), Cauvin (1968), Cauvin (1974a), Cauvin (1983), Gopher (1994), Gopher et al., (1994), Roodenberg (1986).

Some researchers follow Kozlowski (1999) in using the term "Big Arrowhead Industries" (BAI) for lithic assemblages of the PPNB. The "big arrowheads" in question are mainly the Amuq, Byblos, and

Helwan types (Jericho points are rare in the northern Levant). BAI assemblages also feature naviform bidirectional and conical blade cores. Burins, short endscrapers, and perforators are common. The BAI is divided into a variety of regional variants (Table 7.11), and the term BAI has caught on mainly in the northern Levant.

Researchers working in the southern Levant rarely use the term BAI for PPNB lithic assemblages. Instead, they divide the PPNB into a series of chronostratigraphic stages: an Early PPNB (11.0–10.3 Ka cal. BP), a Middle PPNB (10.2–9.7 Ka cal. BP), a late PPNB (9.4–8.9 Ka cal. BP), and a Final PPNB increasingly known as "PPNC" (9.1–8.5 Ka cal. BP). The shared characteristics of Early, Middle, and Late PPNB assemblages have already been described. Internally, there are differences in the relative frequencies of various projectile points, sickle inserts and flaked stone celt types (Barkai 2005, Cauvin 1983, Gopher 1994, Rosen 1997). PPNC lithic assemblages differ from PPNB assemblages by preserving smaller projectile points and sickle inserts with deep denticulations. Technologically, PPNC assemblages show greater evidence for the use of invasive (pressure?) flaking to shape projectile points, knives, sickle inserts, scrapers, and other artifacts. (The word "Tahunian" is used to describe PPNB assemblages in older literature, but this term has largely fallen out of use.)

Late Neolithic (8.4–6.5 Ka cal. BP)

Late Neolithic assemblage groups are defined primarily on the basis of their ceramic wares. This has led to a situation in which there are distinctly named Late Neolithic cultures that differ from one another only trivially in terms of their lithic record. Collectively, Late Neolithic assemblages differ from their Middle Neolithic precursors mainly in decreased naviform blade core reduction and an increasingly prominent flake-based industry. Elongated points are replaced by smaller and more extensively retouched points. These include both scaled-down versions of Byblos and Amuq points as well as some novel forms. In later contexts, points are augmented by transverse arrowheads. Sickle inserts become smaller and seemingly more standardized and more extensively modified by invasive retouch. Stone vessels become increasingly common and more elaborate in their design. Some of these alabaster, limestone, and steatite vessels may have arrived at

Table 7.11. *Variants of Big Arrowhead Industries (Aurenche and Kozlowski 1999)*

Name	Location	Exemplary Occurrences	Distinctive Characteristics
Northeast Variant	northern Syria, southeastern Turkey	Cafer	Large geometric pieces and backed pieces
Taurus Variant	southeastern Turkey	Çayönü	Concave-based points
Euphrates Variant	upper Euphrates Valley	Mureybit IV, Dja'de, Abu Hureyra, Halula	Concave-based points, transverse burins, triangular pieces
Iraqi Variant	northern/western Iraq	Magzalia, Umm Dabaghiya, Bouqras	Conical blade cores, denticulates, picks, and burins on breaks
Sawwan Variant	western Iraq, eastern Syria	el Kowm – Caracol, Sawwan	Sawwan points, transverse burins
Qdeir Variant	Syrian Desert	Bouqras, 'Ain Ghazal	Burins on concave truncations
Western Syrian Variant	Lebanon, western Syria	(Unspecified)	Conical blade cores, dihedral burins, arrowheads with invasive retouch, edge-ground celts
Tahunian Variant	Northern and Central Israel	Jericho	Helwan and Jericho points, Tahunian celts
Negev-Sinai Variant	Negev Desert, Sinai Peninsula	(Unspecified)	Absence of celts and sickle-blades

Levantine sites from production areas in the Zagros Mountains. Obsidian also becomes more common, and source-tracing of this material links it to sources in southern and southeastern Anatolia. Figure 7.28 shows characteristically Late Neolithic artifact-types.

In the southern Levant, the major named Late Neolithic entities are the Yarmukian, Jericho IX, and Wadi Rabah cultures (Garfinkel 1993, Gopher and Gophna 1993). These cultures overlap with one

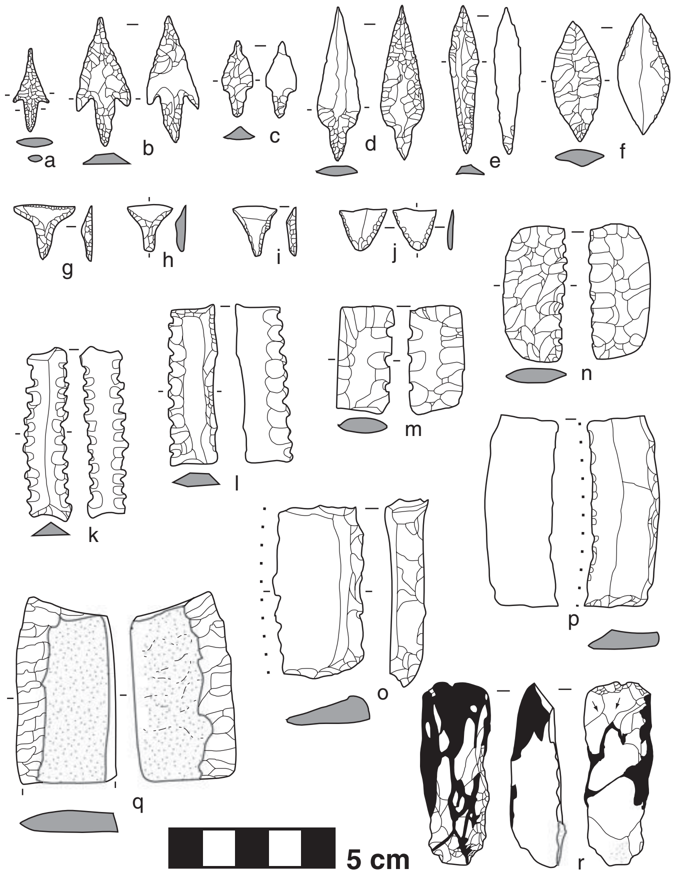


FIGURE 7.28. Late Neolithic artifacts. a–j. projectile points (a–b. Ha-Parsa points, c–d. Nizzanim points, e–f. Herzliya points, g–j. transverse arrowheads), k–p. sickle inserts (k–l. polished pieces with large-scale denticulation, m–n. polished piece with flat invasive retouch, o–p. polished pieces with a curved back), q. cortical knife. r. celt/chisel. Sources: Givat Haparsa (a), Herzliya (g–j), Nahal Issaron (d–e), Nahal Sekher 81–A (b), Nahal Zehora (o–p, r), Nizzanim (f, m–n), Shar Hagolan (c, k–l, q). Redrawn after Alperson and Garfinkel (2002), Barkai (2005), Gopher (1994), Gopher and Gophna (1993).

another geographically, and are generally seen as parts of a stage-wise progression in Neolithic culture change.

Yarmukian assemblages are known mainly from contexts dating between 8.4 and 7.7 Ka cal. BP. The Yarmukian takes its name from Shaar Hagolan (on the Wadi Yarmuk), but sites of this culture occur more widely in the southern Levant. Yarmukian assemblages feature bidirectional blade cores, but they are no longer of the carefully prepared naviform type. Blades are common, but most assemblages are dominated by flakes. Retouched tools include scrapers, bifacial knives, perforators, denticulates, and other common types. Yarmukian projectile points include small variants of the Byblos and Amuq types as well as Nizzanim, Haparsa, and Herzliya types. These points vary widely in shape and many of them feature extensive and invasive parallel flake scars, most likely from pressure flaking. Sickle inserts are shorter, taking on a more standardized short rectangular shape marked by deep and widely spaced notches/denticulation. Some assemblages feature knives and scrapers made of tabular pieces of flint and broad, thin cortical flakes. Among flaked stone celts, working edges are often polished and chisels are more common than axes or adzes.

The Jericho IX Culture (aka "Lodian" in some sources) was first identified at Tel es-Sultan (Jericho). Later excavations at Jericho by Kenyon re-identified assemblages from this level as Pottery Neolithic A (PNA). The few dates for Jericho IX assemblages fall between 7.8 and 7.5 Ka cal. BP in southern Israel, the Jordan Valley, and adjacent parts of Jordan. Our picture of Jericho IX lithic technology is informed mainly by the Jericho excavations and surface collections/test excavations at sites with Jericho IX pottery. Bipolar blade cores are absent. Blades are common in surface collections, but flakes are more common in excavated collections (probably reflecting collection bias). The projectile point inventory is the same as for the Yarmukian, except that transverse arrowheads occur as well. Among sickle inserts, the narrow, rectangular, carefully flaked denticulated types seen in Yarmukian are augmented by broader specimens that are more trapezoidal or arch-backed and extensively pressure-flaked. Tabular and cortical scrapers are common. As in the Yarmukian, chisels are common.

The Wadi Rabah Culture was originally identified at sites near Tel Aviv, but it has been found more broadly in contexts dating to 7.5–6.5 Ka cal. BP. The best documented lithic assemblages are from Nahal Zehora I and II and Munhata Level 2a. Wadi Rabah assemblages are dominated by flakes and flake cores. The latter are mainly unidirectionally prepared. Projectile points are rare, but sickle inserts are common. The latter include rectangular, backed and double-truncated forms. Burins vary widely in frequency, but endscrapers, perforators, truncations, and other common forms occur in low percentages. Notches, denticulates, and various casually retouched flakes and blades are more common. Some assemblages (e.g., Nahal Zehora I) feature chamfered pieces (*chanfreins*).

In the Negev, Sinai, and southern Jordan, researchers identify Tuwailian, Qatifian, and Besorian assemblage-groups. The Tuwailian industry is notable for its association with large, invasively flaked knives (Goring-Morris, Gopher, and Rosen 1994). Although Qatifian and Besorian assemblage-groups differ in ceramics, they share a similar underlying lithic technology. This is a variable mixture of prismatic blade/bladelet production augmented by expedient cores and flakes made from local raw materials. Sickle blades are common but projectile points (other than transverse arrowheads) are rare. There is disagreement over whether these assemblage-groups ought to be considered Late Neolithic or early Chalcolithic and how they are related to the early Chalcolithic Ghassulian industry (Banning 2007, Garfinkel 2009, Gilead 2009).

The taxonomy of Later Neolithic assemblage-groups in the northern Levant is less well organized than in the south. Rather than a stage-wise succession, the Later (or Ceramic) Neolithic Levant is populated by geographically and chronologically distinct entities that are seen as precursors of better-documented Chalcolithic and Bronze Age cultures. Of these entities, only the Pre-Halafian (The Amuq A-B group) occurs in the geographic scope of this book. Pre-Halafian lithic assemblages from the Euphrates Valley appear to be later forms of the BAI entity. The Halafian that follows it is variously described as "Late Neolithic" and "Chalcolithic" but its lithic record is not well described. The Amuq A-B group is found in western Syria at sites dating to 8.0–7.1 Ka cal. BP.

Kozlowski (1999) introduced the term "Agro-standard" for Late Neolithic and early Chalcolithic assemblages from the northern Levant dating to ca. 7.5–6.5 Ka cal. BP. The shared features of these industries (including those of the cultures listed in the preceding paragraph) include standardization of blade production around unidirectional core reduction (including "bullet-shaped cores"), endscrapers, sickle inserts, adzes (sometimes called "hoes"), and rare arrowheads of the same general kind seen elsewhere in the Levant. In stratified contexts, microliths, projectile points, endscrapers, burins, and perforators become less common over time. Meanwhile, there are increased

Table 7.12. *Reduction in Lithic Assemblage Diversity in Late Neolithic and Post-Neolithic Times*

	Late Neolithic	Chalcolithic	Early Bronze	Middle Bronze	Late Bronze	Iron
Projectile points	+					
Burins	+					
Celts	+	+				
Drills	+	+				
Misc. Flake Tools	+	+	+	+	+	
Sickles	+	+	+	+	+	+

Source: Rosen (1996: 138).

numbers of large blade tools, including a wide range of backed and/or truncated types. Many of these backed and/or truncated blades were used as sickle inserts. The proportion of obsidian in lithic assemblages also increases. Bullet-shaped cores become more common in both flint and obsidian blade production, suggesting a degree of craft specialization. These latter phenomena are thought to reflect the development of a market-based system of obsidian exchange, one servicing larger and more permanent towns and villages. Although one might wish for a somewhat more descriptive term for the lithic assemblages of the northern Levant (e.g., "North Levant Late Neolithic-Chalcolithic"), "Agro-standard" adequately captures the sense that these assemblages reflect the adaptations of humans living in stable villages heavily dependent on agriculture and pastoralism.

The Stone Age in the Levant after the Neolithic

The Stone Age in the Levant did not end with the Late Neolithic Period (6.5 Ka cal. BP). Stone tools continued to be manufactured in the Chalcolithic, the Bronze Age, and even the Iron Age (Rosen 1997). The "decline and fall of flint," as Rosen (1996) puts it, played out over several millennia and involved both a reduction in the amount of lithic material being deposited at archaeological sites and in a reduction in assemblage diversity (Table 7.12). The major falloff in lithic artifact discard occurred in the Early and Middle Bronze Ages 3500–1550 BC/5.5–3.5 Ka cal. BP. Projectile points and burins were the first major classes of Neolithic tools that ceased to be produced in early Chalcolithic times. Drills and celts continued to be made during the Chalcolithic, but vanish in the Early Bronze Age, possibly as adequate supplies of bronze for making drills and axes became more readily available. Stone sickles persist until Iron Age times. Rosen notes that "ad hoc" tools (i.e., miscellaneous retouched and unretouched flakes) are rare in Iron Age contexts. It is likely, however, that people knapped stone tools opportunistically when they needed expedient cutting tools, as they do in so many parts of the world even to this day. In historic times, flaked stone tools were used for threshing sledges and gunflints (Bordaz and Bordaz 1973; Whittaker, Kamp, and Yilmaz 2009).

V. OVERVIEW

Epipaleolithic versus Neolithic Differences

There are several important differences between the Neolithic and Epipaleolithic lithic technologies. During the Neolithic, core technology became divided into seemingly unstandardized, even expedient, flake production and highly standardized prismatic blade production. Pressure-flaking and bifacial thinning retouch came to be used more often. Geometric microlithic tools decreased far below their former levels of popularity. Retouched tools increased in standardization within what appear to be functionally specialized groupings (i.e., projectile points, sickle inserts, celts, etc.). Groundstone tools are more common and more complex. Though the timing of these shifts differs between the Levant and elsewhere, similar kinds of changes occurred in early Holocene-age lithic assemblages in Mediterranean North Africa, the Nile Valley, Arabia, montane Western Asia, and southeastern Europe. These parallels suggest similar forces to those influencing the Levantine lithic record (chiefly increased sedentism and food production) were at work in these other regions. In each region, hunting and gathering adaptations that had withstood millennia of rapid and wide-ranging shifts in climate were supplanted by adaptive strategies whose dynamic shifts occurred against the backdrop of a relatively stable Holocene climate.

Ways to Improve Anthropological Relevance of the Neolithic Evidence.

That there is no standard Neolithic stone tool type-list such as those used to organize the lithic evidence from earlier periods is a major obstacle to progress in Neolithic stone tool analysis. Appendix 1 of this book offers one such possible list as a prototype on which Levantine prehistorians can build either a more comprehensive type-list for the Neolithic Period or one that merges Neolithic and Epipaleolithic typologies. The latter option, in this author's view, would go a long way toward removing the seemingly arbitrary distinctions between Late Epipaleolithic and Early Neolithic records.

Neolithic stone tool typology is more overtly functional than Paleolithic typology. Arrowheads/projectile points, sickle inserts, celts, and the like all conjure up images of tools with specific functions. However, there is significant metric, morphological, and technological variability within each of the named artifact-types, variability that suggests functional variability as well. The categories of projectile points and knives, in particular, probably need an overhaul along more strictly technological and morphometric lines.

It would be useful for formally defined Neolithic assemblage-groups to be defined on the basis of the lithic evidence alone. Given the richness of the Neolithic archaeological record, it is only natural that lithic variation plays less of a role in taxonomic frameworks for the Ceramic Neolithic and Pre-Pottery Neolithic periods. Many Late Neolithic cultural entities, and nearly all Chalcolithic ones, are defined on the basis of ceramic wares. However, there is no middle-range theoretical justification to expect parallel patterns of lithic and ceramic variation. Both may track similar dimensions of human behavioral variability, or different ones. The simple fact is that no one knows which of these assumptions is correct for particular groups of assemblages. As the matter stands today, however, our lithics systematics assume that the lithic, ceramic, architectural, and other components of Neolithic assemblages vary in parallel with one another. Having a lithics-based systematics for the Neolithic stone tool record would help Levantine prehistorians test hypotheses about sources of lithic variation independent of assumptions about variation in other lines of evidence.

A final issue, one that goes beyond lithic analysis, is the need for some kind of unifying chronostratigraphic framework for the entire region. The present situation, in which the frameworks for evidence from 12.2–6.5 Ka cal. BP divide along lines of post-colonial Francophone and Anglophone spheres of influence is an obstacle to progress in understanding regional patterns of behavioral variability during a crucial period in human evolution.

One concrete step toward creating such a framework would be for Levantine prehistorians to abandon the practice of publishing dates in Christian calendar years and to begin publishing paired sets of dates in uncalibrated and calibrated radiocarbon years before the present. For the latter, it is increasingly important the specific method of calibration needs to be clearly indicated. This simple step would make it vastly easier to make intra-regional comparisons of the lithic evidence, and of other archaeological findings.

8

CONCLUSION

The more than 1.5 million-year-long lithic record for the Levant preserves evidence for important patterns of behavioral change and variability. The most obvious pattern in this record is the increasing investment of time and energy to stone tool production. None but a very few Lower or Middle Paleolithic tools required more than a few minutes knapping effort, or fabrication tools other than stones and bones readily at hand. Upper and Epipaleolithic tools were significantly more labor-intensive, requiring pressure-flakers, punches, and careful attention to core geometry. In contrast, making reproductions of Neolithic stone tools, particularly groundstone tools, can consume hours, or even days, of focused labor. This increased time and energy devoted to tool production can only make sense if, over the course of time, stone tools played more important roles in human adaptation. This chapter develops this hypothesis. Before doing so, however, it reviews the biases that influence our perceptions about variability in the lithic record and sets forth a comparative approach to the lithic evidence that contrasts with more common narrative approaches to this evidence.

I. BIASES INFLUENCING THE LITHIC RECORD

Archaeologists' hypotheses about the past are based on the evidence that is preserved and that we have recovered by survey and excavation. The lithic record is less affected by the preservation biases that degrade the archaeological record for organic materials, but it is not free of biases that influence what we find and how we perceive archaeological variability. The most important of these biases are geological attrition, historical factors influencing the practice of archaeology, and variability in archaeological method and theory.

Geological Attrition

Time and geological attrition have strong biasing effects. Simply put, there are more potentially discoverable archaeological contexts of recent age than there are older ones. Inevitably, sample abundance, richness, and variability are greater in recent contexts than in ancient ones. This can make it difficult to test hypotheses about trends in the archaeological record. In the past, researchers have cited greater numbers of recognizably distinct lithic artifact-types in recent contexts as reflecting some deeper underlying evolutionary process, such as the origins of language and/or increasingly complex behavioral capacities (Isaac 1986, Leroi-Gourhan 1993). Although it may be true that more distinct stone tool types reflects greater behavioral complexity (or not), it is almost certainly true that our ability to recognize morphologically distinct artifact-types is better in the richly sampled Neolithic, Epipaleolithic, and Upper Paleolithic periods than it is for comparatively under-sampled Middle and Lower Paleolithic periods.

Historical and Geographic Factors

Historical and geographic factors also bias the lithic evidence. Early-twentieth-century prehistoric investigations in the Near East focused on cave sites along the Mediterranean Coast and Jordan Valley. From what we now know, these were probably focal areas for Paleolithic and Neolithic settlements. The reasons these sites were selected, however, did not reflect this recently acquired knowledge. The locations of early excavations, and no small number of recent ones, reflect the positioning of roads, administrative structures, and political boundaries – factors that were irrelevant to prehistoric settlement. Sites that were the focus of these early excavations were often seen as "type-sites" for particular time periods and evidence from them has had a disproportionate impact on models of archaeological variability. Because many of these sites were so thoroughly excavated using primitive methods (by today's standards), the data recovered from them is difficult to correlate with findings from more recently excavated sites. As visitors to these sites today can confirm, vast quantities of retouched tools and débitage were discarded at the sites of these early excavations.

As road networks moved inland over the second half of the twentieth century, a greater proportion of recent excavations focused on the arid interior of the Levant and in Syria, Jordan, the Negev Desert, and the Sinai Peninsula. These arid inland regions were probably of marginal or only episodic settlement value to prehistoric humans. Today, ironically, we often know far more about the archaeological context for the lithic archaeological record at ephemeral sites located in the arid interior Levant than we do about sites located in more optimal habitats at lower elevations and along the coast.

Variability in Archaeological Method and Theory

Prehistoric archaeology in the Levant is an international enterprise. Findings are mostly published in English and French, but also in Hebrew, Arabic, Turkish, German, Japanese, and Spanish, among other languages. There are, however, significant patterns in this diversity, patterns arising from the contingent facts of the region's recent history. Prehistoric archaeology in countries politically aligned with the Anglophone world, such as Israel and Jordan, tends to follow Anglo-American lithic analytical traditions. Their systematics emphasize technological variation and invokes economic/ecological factors to explain any patterns discovered. Prehistoric archaeology in Lebanon and Syria has a stronger "Continental" perspective (Clark and Riel-Salvatore 2006, Sackett 1991). This can be seen in the concern for formal artifact systematics and typology. Explanations of patterned variability invoke cultural differences among prehistoric populations. These differences do not make comparisons of North versus South Levantine evidence impossible, but they can create the impression of differences in the lithic evidence that are more apparent than real. This problem is less pronounced for earlier Paleolithic periods, which involve research by a smaller number of scholars among whom there is a broad consensus about how to describe lithic artifacts. It is more pronounced with the evidence for Epipaleolithic and Neolithic periods. A greater number of researchers work on these later periods, and there are more seemingly intractable differences over how to describe artifact-types and assemblage-groups.

A further historical influence on perceptions of Levantine lithic variability is that it very much looks to Europe, not just for method and theory, but for larger interpretive issues. Except in Israel, most prehistoric archaeologists active in the region are either from European countries or were trained in European institutions. This gives an oddly Eurocentric focus to prehistory in the "crossroad of the continents." One can see this bias reflected in the disparity between the numerous papers comparing the Levantine lithic evidence to its European counterparts and the relatively smaller number of works comparing it to evidence from North Africa, the rest of the Arabian Peninsula, and southern Asia. This bias does not strongly influence the interpretation of the Levantine lithic record in its own geographic context, nor in a larger evolutionary perspective. It does, however, make it difficult for one to objectively evaluate hypotheses about whether the Levantine lithic evidence is more similar to Europe than it is to these other, closer regions.

II. PATTERNS IN THE LEVANTINE LITHIC RECORD

Patterns in the Levantine lithic evidence can be sought using either a narrative approach or a comparative approach. In narrative approaches, which are the most common in prehistory, one chronicles the successive transformations of quasi-historical entities, such as stone tool industries and cultures from older entities into younger ones (Figure 8.1). Specific patterns of change or "transitions" are attributed to processes of culture change analogous to those observable in historical contexts (e.g., extinction, migration, diffusion, and economic/ecological transformations). The main strength of this approach is that, in seeking explanations for past behavioral change, it calls on models familiar from ethnology. There are many advantages to using narrative explanations for evolutionary phenomena. Chief among these is familiarity of form. Narrative explanations are cultural universals and they are to be found among the oldest of the world's literature. Their main weakness, as Landau (1991) demonstrated in her analysis of narrative explanations of the fossil record, is that choices made in constructing these narratives (i.e., which fossils are central

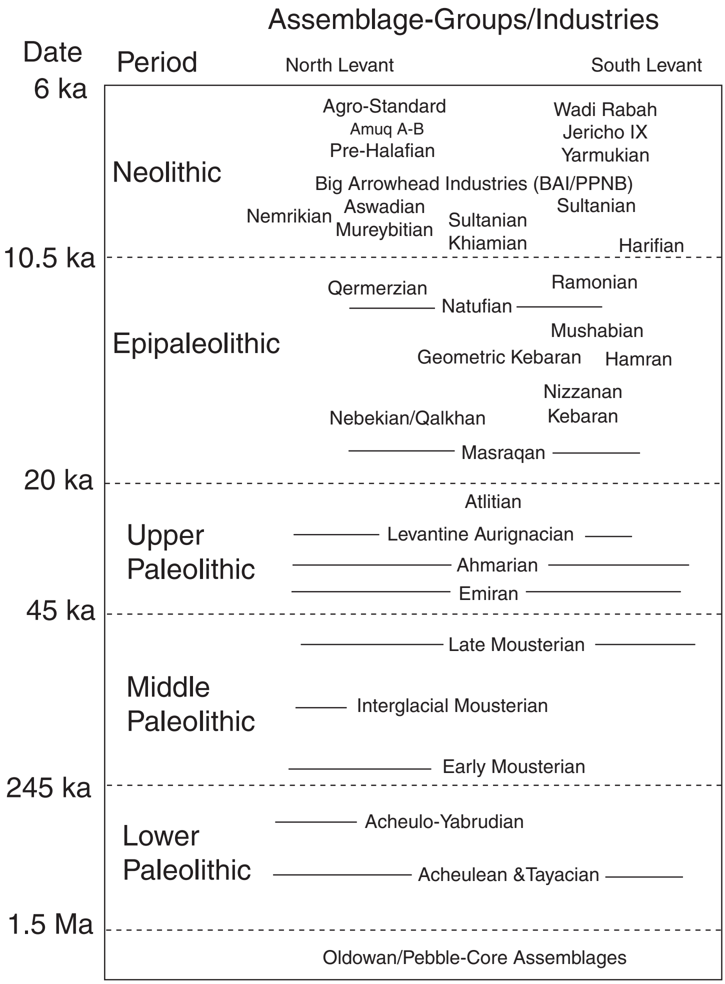


FIGURE 8.1. Time chart showing lithic assemblage-groups/industries.

and which are dead ends, what were major versus minor forces of evolutionary change) often arise from subjective biases on the part of individual researchers. Narrative explanations of evolutionary phenomena have a strong and seemingly irreducible subjective component to them.

With respect to their application to the lithic evidence, narrative approaches' most significant weakness is that one simply does not know, and has no way of verifying, whether named stone tool industries, the quasi-historical entities of archaeological lithic analysis, actually correspond to specific groups of humans or earlier hominins. In fact, there are compelling reasons to doubt such equations. All but the most recent assemblage-groups (i.e., later Epipaleolithic and Neolithic) are spread out over tens of thousands of years. These periods of time are orders of magnitude greater than the duration of any known historical or ethnographic human group. This makes it vanishingly improbable that Levantine stone tool industries are meaningfully analogous with any of the historical and ethnographic entities familiar to anthropologists. One can try to write prehistory in terms of lithic industries, but the results will not be convincing, realistic, or justifiable in terms of anthropological theory. That this is a longstanding archaeological practice in Levantine prehistoric archaeology does not make it any less likely to be wrong (Shea 2011e).

Comparative approaches are less common in prehistory and somewhat more common in paleontology and evolutionary biology (Nunn 2011). Comparative approaches search for differences between paired sets of chronologically successive archaeological samples with the goal of producing a range of hypotheses that explain those differences. One advantage of a comparative approach to the lithic record is its symmetry with the goals of evolutionary explanation. Narrative approaches track relationships among lithic industries by patterns of similarity. Comparative approaches focus on differences. This is an important distinction, because, in evolution only differences matter. (Similarities merely reflect descent from a common ancestor or convergent evolution.)

The comparative approach to the Levantine lithic record taken here focuses on differences in tool-making strategies. Although there is much disagreement over whether particular named stone tool industries correspond to meaningful biological, social, or cultural differences among prehistoric humans, few dispute that stone tools were made to solve problems requiring sharp cutting edges, grinding, or crushing surfaces, and (in the latest phases of prehistory) containers and/or cooking vessels. There is a lot of disagreement about the uses to which particular stone tools were put, but again, countless studies of recent human and nonhuman primate tool use demonstrate relationships between the strategies by which stone and other tools are made and how they are integrated with broader patterns of human adaptation

(Nelson 1988, Oswalt 1973). These studies suggest that a comparative approach to the Levantine lithic record, one aimed at elucidating differences in stone tool making strategies, will yield results that link the lithic evidence to broader patterns of evolutionary change. There remains a subjective component to this analysis, too; but inasmuch as it focuses on difference, a quality that can be objectively evaluated with evidence, it offers advantages over narrative approaches that reflexively equate similarity with continuity.

Lower Paleolithic

Hominins had been making and using stone tools for more than a million years before the earliest-dated archaeological sites were deposited in the Near East. Not surprisingly, there is a lot of technological variability among even the earliest Levantine Lower Paleolithic assemblages (Chapter 3). The most obvious dimension of this variability is between pebble-core technology and large cutting tool (LCT) technology. Pebble core technology is versatile, but it has two significant limitations. First, because of their roughly spherical or cuboid shapes, detaching flakes from pebble-cores removes relatively large portions of potential core edge as flake striking platforms. Consequently, the yield of flakes per pebble core is small and closely correlated with the starting size of the core (Braun et al. 2005). Secondly, their shape limits the extent to which core edges can be used as effective cutting edges. There are few cutting tasks at which pebble-cores outperform a sharp-edge flake of equivalent mass (Tactikos 2005). These factors make transporting heavy pebble cores any great distance a technological strategy with relatively high costs and low benefits. For habitual tool-users, however, one would expect there to be strong selective pressure for tool portability, if only to minimize the costs of having to pass up an exploitable resource owing to inadequate technological aids. LCTs may reflect efforts to reverse this cost/benefit ratio and core portability by "scaling up" core size (increasing potential flake yield) and elongating cores asymmetrically along two or more dimensions (increasing potential functional cutting edge on the core itself) (see Figure 8.2). Levantine hominins pursued several strategies referable to such scaling up, by reducing LCTs from larger blocks of stone, by producing trihedral picks (increasing cutting edge by 50 percent over that of a biface of equivalent size), and by knapping large flakes and turning them in to LCTs. Shifts between pebble-core and LCT production may reflect alternation between those strategies that yielded versatile flake tools at minimum cost in terms of time, effort, or technological knowledge (pebble core production) and those strategies that called for heavy, but efficiently portable, combination core-tools (LCTs).

Miniaturization is a second interesting aspect of Lower Paleolithic technology. From the very start (e.g., 'Ubeidiya, Revadim, etc.), Levantine assemblages preserve evidence for almost unimaginably small cores, flakes, and retouched tools. Such miniaturization takes the forms of intense core reduction, extensive and invasive retouch, and flake segmentation. All of these knapping strategies essentially increase the amount of cutting edge per stone tool, but without the reduction in tool mass one sees in Epipaleolithic microlith production. Superficially, this would seem explicable as a strategy for boosting the utility of raw material supplies at particular sites, but much more remains to be learned about Lower Paleolithic "microlithization."

These features of the Lower Paleolithic lithic record are not unique to the Levant. Pebble cores are universal features of Lower Paleolithic stone tool production. LCTs have a more patterned distribution, being somewhat more common in western and southern Eurasia and Africa and rare in northern and eastern Asia. Much has been written about the "Movius Line" dividing handaxe-making western hominins from their eastern counterparts (Lycett and Bae 2010). Differences in LCT production at this scale are plausibly referable to variability in the strategic factors influencing hominin tool production of the sort outlined previously. Small-scale stone tool technology has not received as much archaeological attention as variation in LCT production, but this too is a phenomenon seen in other regions.

Levantine later Lower Paleolithic Acheulo-Yabrudian contexts show a pattern of variability in tool making strategies not precisely replicated elsewhere. Yabrudian scrapers suggest a strategy of curating large, thick flake tools by intense and invasive retouch, while Amudian blades suggest a strategy of producing large numbers of small, thin, and narrow tools with individually short use-lives. (The strategy of prolonging blade use-life by distal-proximal retouch [i.e., making endscrapers] was not much used by Lower Paleolithic hominins.)

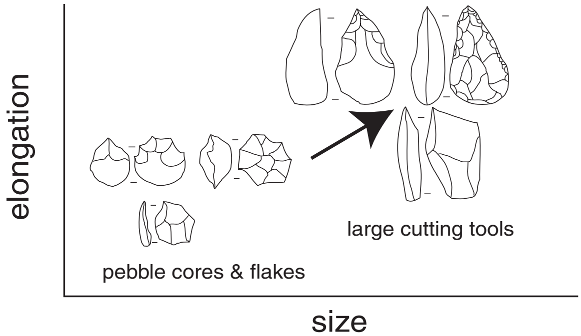


FIGURE 8.2. Pebble-cores scaled up into large cutting tools.

Intensive curation of relatively thick flake tools is common among Eurasian Middle and Later Pleistocene contexts, but less often seen among African Middle Stone Age assemblages. Prismatic blade production occurs in some African Middle Pleistocene contexts but it is relatively uncommon in Eurasian ones.

Metric variation among handaxes from Levantine Lower Paleolithic contexts supports a hypothesis of increasing tool dependence. There have been many debates about the functions of LCTs, particularly handaxes (Wynn 1995), but the least controversial of these is the longstanding hypothesis that they were a combination of heavy-duty cutting tools and sources of flakes (Leakey 1960, Toth 1987). Across the board among Lower Paleolithic assemblages, more frequent and/or prolonged uses ought to have led to increased artifact curation (by retouch and/or transport). As the result of such prolonged curation, handaxes from more recent contexts ought to exhibit smaller values for those dimensions most closely related to their continued functionality as cores/cutting tools. Length is the most obvious of these variables. As shown in Tables 8.1 and 8.2, mean length values for bifacial LCTs among Levantine Lower Paleolithic assemblages exhibit precisely this decreasing trend over time.

Middle Paleolithic

The two most obvious differences between Levantine Lower and Middle Paleolithic stone tool technology are widespread abandonment of LCT production and increased use of preferential modes of Levallois

Table 8.1. *Mean Length Values for Bifaces from Acheulian and Acheulo-Yabrudian Assemblages*

Sample	Mean (mm)	sd	n	Reference
ACHEULO-YABRUDIAN				
Bezez Cave Level C	105		112	1
Misliya Cave Terrace	84.62	19.97	5	2
Tabun Eb & Ea	87.6			3
Tabun Jelinek Unit XI (Bed 75)	85.09	1.85	75	4
Tabun Jelinek Unit XI (Bed 76)	72.65	0.88	333	4
Tabun Jelinek Unit XII (Bed 79)	72.07	1.38	134	4
Tabun Jelinek Unit XII (Bed 80)	69.39	1.97	66	4
Tabun Jelinek Unit XIII (Bed 83)	83.05	2.05	61	4
Tabun Jelinek X (Bed 70)	84.54	2.26	50	4
Tabun Ronen LYA (Layers 210–240)	75.57	11.75	16	5
Tabun Ronen MYa (Layers 250–270)	69.28	15.33	38	5
Zuttiyeh	93.8			3
LATE ACHEULIAN				
Azraq C-Spring Pb	101		2	6
Azraq C-Spring Qa	88		6	6
Azraq C-Spring Qb	82.8		7	6
Azraq C-Spring T	107.7		58	6
Azraq Lion-Spring	102.9		38	7
Berekhat Ram	67.5	16.15	8	8
Beth Uziel	87.2			3
Holon Level D	105.4	36.9	84	9
Kissufim	105.3			3
Maayan Barukh	114			3
Rephaim-Baqa	102.6			3
Revadim Quarry-Early	89.16	27.04	75	10
Revadim Quarry-Late	73.3	18.67	10	10
Ruhama	93.7			3
Sahel el Koussin/Baram	89.7			3
Tabun Ec	84.3			3
Tabun Ed	85			3
Tabun F	86.4			3
Tabun Ronen EUA (Layers 350–370)	77.28	16.67	15	5
Tabun Ronen LUA (Layers 310–340)	71.76	14.55	58	5
Umm Qatafa D1	93.2			3

Sample	Mean (mm)	sd	n	Reference
Yiron	89.6			3
Tabun Jelinek XIV (Unit 90)	74.05	1.43	125	4
MIDDLE ACHEULIAN				
Gesher Benot Ya'acov	142.12	23.5	42	11
Gesher Benot Ya'acov V	144.1			3
Evron-Quarry	94.4			3
Holon	100.8			3
Umm Qatafa D2	117.5			3
Umm Qatafa E	135			3
EARLY ACHEULIAN				
Latamne	166.6			3
Ubeidiya I-15	143.8	31.86	15	12
Ubeidiya I-15	153.1			3
Ubeidiya II-36	136.8	31.49	5	12
Ubeidiya K-30	138.71	30.21	57	12
Ubeidiya K-30	148.8			3

REFERENCES Key: 1. Copeland (1983b: 163), 2. Zaidner et al. (2006: 247), 3. Bar-Yosef (1975: 588), 4. McPherron (2006: 279), 5. Gisis and Ronen (2006: 148), 6. Copeland (1989a: 387), 7. Copeland (1989b), 8. Goren-Inbar (1985: 18), 9. Chazan and Kolska-Horwitz (2007: 61), 10. Marder, Mielski and Matskevich (2006: 253), 11. Goren-Inbar and Saragusti (1996: 25), 12. Bar-Yosef & Goren-Inbar (1993: 220).

core technology (Chapter 4). Both are plausibly referable to increased dependence on stone tools. From a tool-user's perspective, LCTs' main disadvantage is that they are heavy, but their weight constitutes a cost that must be borne if they are components of mobile toolkits. Increased tool use and demand for greater quantities of cutting edge per unit mass of transported stone would have elevated these costs and, presumably, fostered selective pressure to reduce them.

There are several ways to reduce these costs. The simplest is to reduce LCT mass by invasive "thinning flakes" achieved by soft-hammer percussion. The invasive flaking patterns seen on Acheulian bifaces from Middle Pleistocene times onward are consistent with such a strategy. A different strategy would be either (1) to "split" a LCT laterally into halves of approximately equal area, but roughly 50 percent of the thickness, or (2) to "slice" it into laminar pieces of variable length but much reduced width or thickness (Figure 8.3). Although

Table 8.2. *Summary Statistics for Variation in mean Biface Length for Early, Middle, and Late Acheulian, and Acheulo-Yabrudian Assemblages (Computed from Data in Table 8.1)*

Assemblage Group	Mean (mm)	SD (of means)	n Assemblages
Acheulo-Yabrudian	81.9	10.8	12
Late Acheulian	90.1	12.6	23
Middle Acheulian	122.3	21.4	6
Early Acheulian	148.0	11.0	6

Note: Raw counts of artifacts measured are not published for all samples.

there are LCTs that were recycled as Levallois cores and as blade cores, neither of these strategies is easily executed on actual handaxes. Moreover, reorganizing inclined cores (pebble-cores and LCTs) into parallel or platform cores (Levallois cores and prismatic blade cores) entails an unavoidable amount of waste. A less wasteful alternative would be to "scale up" prior Lower Paleolithic Levallois and prismatic blade core production to produce longer and broader "preferential" Levallois flakes with higher circumference to mass ratios (and thus greater potential utility). This strategy has the further advantage of producing flakes with irreducible minimum volumes than LCTs (Kuhn 1996). This last strategy seems to have been the one adopted by Levantine Middle Paleolithic toolmakers.

There are many ways to hold a stone tool and to cut with it, but there are far fewer ways to hold that tool so that it cuts efficiently with minimum chance of injury. It is unlikely that hominin tool users would long remain oblivious that tools of some particular shapes and sizes work better than others – either for use in particular tasks or as general-purpose tools. This recognition likely led to more stereotyped core reduction strategies and more consistently patterned choices about how the resulting flakes were used. Middle Paleolithic retouched artifact-types are generally viewed as more morphologically standardized than Lower Paleolithic types, albeit in a different way. Many Lower Paleolithic cores and retouched tools resemble one another as the result of reduction. (Any pebble or cobble, knapped long enough, will eventually resemble a discoid or a polyhedron.) Morphological convergence by reduction is a factor in Middle

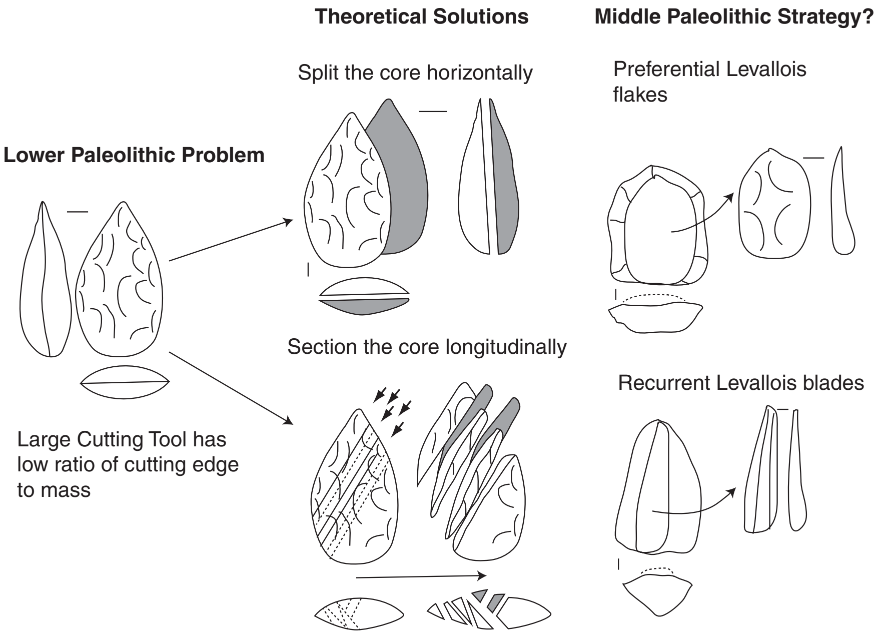


FIGURE 8.3. Large cutting tool "split" and "sliced" into Levallois centripetal and recurrent flakes.

Paleolithic core variability as well, but one novel aspect of Middle Paleolithic core technology is repetitive patterns of core preparation and reduction seemingly aimed at recovering morphologically consistent flakes, blades, and points. A shift toward more standardized patterns of flake tool production during the Middle Paleolithic is consistent with a hypothesis of increased stone tool use.

The Middle Paleolithic Period did not last as long as the Lower Paleolithic Period. Nevertheless, an evolutionary trend toward increased dependence on tools ought to be reflected in diachronic shifts in the metric dimensions of Middle Paleolithic stone tools. Specifically, increased tool dependence ought to have elevated discard thresholds for cores in general and reduced core sizes at discard. As cores diminish in size, they acquire more complex surface geometries, and the flakes detached from them become thinner and more variable in shape. Increases in the mean and variance values of width versus thickness of whole flakes through the long Lower–Middle Paleolithic sequence at Tabun and other Middle Paleolithic sites (Jelinek

Table 8.3. *Variation in Width/Thickness Ratios for Whole Flakes in Tabun Cave and other Sites (Jelinek 1982a)*

Tabun Units (Cultural Period)	Mean	Median	Variance	n
I (Later Middle Paleolithic)	4.633	4.249	5.049	1377
II (Early Middle Paleolithic)	4.547	4.169	4.049	334
III–VIII (Early Middle Paleolithic)	4.361	4.000	3.956	1275
IX (Early Middle Paleolithic)	4.258	3.999	3.128	743
X (Lower-Middle Paleolithic)	3.970	3.643	2.898	424
XI (Acheulo-Yabrudian)	3.465	3.143	2.709	2373
XII (Acheulo-Yabrudian)	3.552	3.273	2.570	976
XIII (Acheulo-Yabrudian)	3.520	3.250	2.391	1905
XIV (Late Acheulian)	3.210	2.917	1.935	766

1982a, 1982b) are consistent with this hypothesis of increased tool dependence (Table 8.3).

Hafting is a quantum leap in the time and energy allocated in preparation for tool use. Wooden handles must be carved, mastic and fibers prepared, and all three of these materials successfully articulated with stone artifacts before use. Standardized core reduction strategies that yield a morphologically consistent range of flakes, as Levallois core reduction does, would have reduced the costs associated with fitting stone tools to previously carved wooden handles. Limited though the evidence is at present for hafted stone tools from Levantine Middle Paleolithic contexts (Boëda et al. 1996, Shea 1988), that there is any such evidence at all signals a decided shift toward increased dependence on stone tools.

Upper Paleolithic

The Upper Paleolithic Period in the Levant witnessed the abandonment of Levallois core technology and the increased use of prismatic blade core technology (see Chapter 5). This shift has long been viewed as a simple matter of increasing the yield of cutting edge per unit mass of stone, but recent experimental studies challenge this assumption (Eren, Greenspan, and Sampson 2008). It is not necessarily the case that prismatic blades recover more cutting edge than flakes. A broad, thin flake can recover as much cutting edge as a narrow, thick blade.

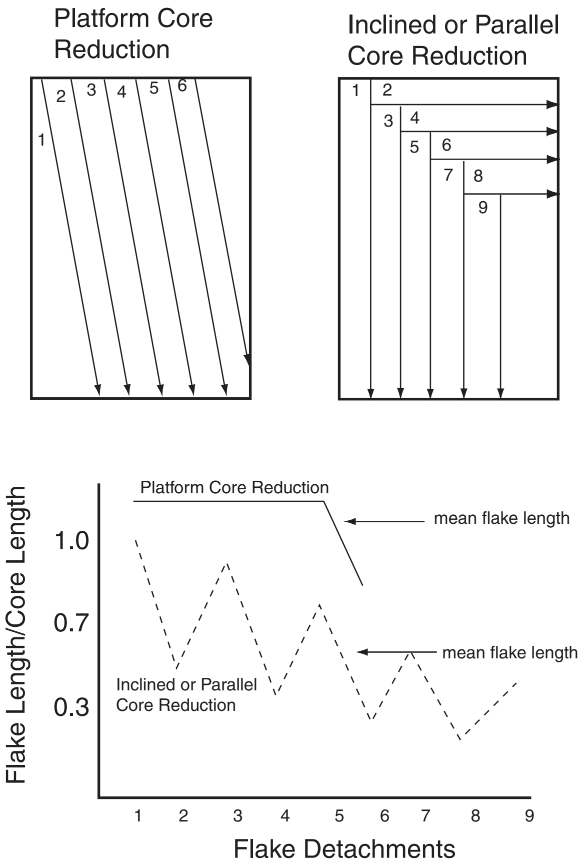


FIGURE 8.4. Platform versus inclined and parallel core reduction. Above: Section view of platform (left) and inclined/parallel core reduction. Bottom: Graph of ratio of flake length/core length ratio over a series of flake detachments.

Prismatic blade cores are, essentially, elongated platform cores. As a strategy, prismatic blade core reduction's advantage over inclined and parallel core reduction is that it maximizes the length of detachable flakes while delaying the point at which a core becomes too short or thin for use to continue (Figure 8.4). Platform core reduction yields flakes whose length is, on average, greater than or equal to the core length until very near the end of core utility. Inclined core reduction and parallel core reduction produce flakes whose length values decline arithmetically along with successive removals. The adoption of platform core reduction strategies by Upper Paleolithic humans may reflect efforts to optimize core utility in the context of more technologically mediated adaptations.

If dependence on stone tools increased in Upper Paleolithic times, one would also expect to see increased standardization of tool designs, increased use of hafting technology, and increased efforts to prolong the use-lives of individual artifacts. All these developments occur during the Levantine Upper Paleolithic Period. One of the hallmarks of the Upper Paleolithic record (and contrasts with earlier periods) is that there are lithic and other morphological artifact-types with constrained geographic and chronological distributions. Although this patterning in the archaeological record does not rise to the degree of standardization we see in recent industrial contexts, it is consistent with more stereotyped and culturally conditioned patterns of stone tool use. Upper Paleolithic contexts also furnish evidence for modes of stone tool use, such as use as projectile armatures, that require effective hafting technology. Further evidence of increased use of hafting technology by Upper Paleolithic humans can be seen in in-bulk production of small retouched tools, such as El Wad points and "thumbnail" scrapers, that are simply too small to be used effectively while held directly in the hand. The recurring alignment of retouched edges perpendicular to tool distal-proximal axes (resulting in endscrapers and burins) is an effective strategy for prolonging individual tool utility. The abundance of small carinated pieces in Upper Paleolithic contexts (Belfer-Cohen and Grosman 2007) may be a further indication of the elevated tool discard thresholds that accompanied further increases in stone tool dependence.

Epipaleolithic

The distinctive qualities of the Epipaleolithic lithic record in the Levant were the adoption of microlithic technology and the production of groundstone tools (see Chapter 6). These developments mark a bifurcation in strategic objectives – microlithic technology trending toward functional versatility, groundstone technology moving toward functional specialization. Both these shifts also signify a further increase in tool-dependent behavior, specifically an increased allocation of effort in tool production, presumably for at least the same or better energetic returns.

Epipaleolithic microliths appear to have been made by two convergent strategies – the truncation and segmentation of blades/bladelets and of flakes struck from shorter platform cores (see CUP Website Figure 43). These strategies have antecedents in Upper Paleolithic technological strategies and both were deployed simultaneously, albeit to varying degrees, in Epipaleolithic assemblages. Both strategies create small tools with high ratios of circumference to mass, but low ratios of cutting edge to mass. This is because backing, truncation, or retouch blunts substantial amounts of their circumference. At face value, this seems a counterintuitive strategy for provisioning people or places with stone tools, except that in this case the "scaling down" of lithic technology was accompanied by hafting technology. Because of their modular design, geometric microliths can be integrated into a wide range of uses as components of hafted tools. They can serve as projectile armatures, as blades for knives and sickles, or as insets in plant-processing boards (Clarke 1976). The shift to microlithic blade production in the Epipaleolithic is "intensification" (greater energetic output for the same or lower energetic return) in the sense that (all other things being equal), knapping two small blades takes twice the effort of knapping one larger one with equivalent cutting edge. (Further evidence of intensification of blade production across Middle, Upper, and Epipaleolithic periods is discussed later in this chapter.) The overall smaller sizes and intense reduction seen among many categories of Epipaleolithic stone artifacts is consistent with higher energetic inputs and greater tool dependence.

Epipaleolithic groundstone tool technology marks an important departure in Levantine lithic technology. Groundstone tool production requires amounts of time with no parallels among earlier flaked-stone technology – hours or days compared to seconds or minutes. Unlike for most flaked stone tools, moving larger mortars and pestles entails very high transport costs and a severe loss of time and/or energy if they are lost or broken. Finally, groundstone tools are functionally specialized in ways flaked stone tools are not. There are not many things one can do with mortars, pestles, or querns, other than grinding seeds or pigments, without compromising their pulverizing capabilities. Epipaleolithic groundstone technology marks the beginning of a trend toward functional specialization that expands into other dimensions of lithic technology during Neolithic times. This shift toward more functionally specialized tools may be a side effect of increased sedentism. Reduced residential mobility and increased logistical movements to supply stable residential sites ought to have relaxed selective pressure against technological strategies employing heavier and more specialized implements. These specific features of the Levantine record, microlithization and groundstone tools, appear under similar circumstances throughout much of Late Pleistocene–Early Holocene times, usually together with other evidence for increased sedentism and economic intensification (Elston and Kuhn 2002, Hayden 1989).

Middle Paleolithic, Upper Paleolithic and Epipaleolithic

Some of the metric evidence for increased dependence on stone tools, namely that associated with blade production, cuts across Middle Paleolithic, Upper Paleolithic, and Epipaleolithic periods. Samples of about 75–100 blades each from twelve sites (Wiseman 1993) show reductions in length, width at midpoint of length, thickness at midpoint of length, and in both the width and thickness of striking platforms (Table 8.4). Taken together, these data suggest a trend toward the production of ever smaller and thinner blades. Such blades recover more cutting edge per unit mass of stone by the use of smaller striking platforms which conserve core striking platform surfaces, thereby prolonging core utility. Assuming there are no differences in the costs associated with blade production between these samples, these data suggest a strategy of optimization, of efforts to increase returns on labor investment. This trend is inferred from a limited sample of artifacts, but it is consistent with the hypothesis of increasing tool-dependent behavior in the later Pleistocene/early Holocene Levant.

Neolithic

Three novel qualities of the Neolithic record point to increasing dependence on stone tools: (1) functional specialization, (2) symbolic overdesign, and (3) the growing ubiquity of groundstone tools. The first two of these qualities are not easily quantified, the groundstone tool evidence is.

The more one uses tools, the greater the energetic payoff for functionally specialized tool designs. As noted in Chapter 7, Neolithic

Table 8.4. *Metric Variation Among Blades from Selected Levantine Late Pleistocene Contexts (Data From Wiseman 1993)*

Site & Level (n = max-min.)	Time Period	Flake Length Mean (sd)	Midpoint Width Mean (sd)	Midpoint Thickness Mean (sd)	Striking Platform Width Mean (sd)	Striking Platform Thickness Mean (sd)
Hayonim B (99–95)	Late Epipaleolithic	33.9 (14.2)	11.7 (4.7)	3.6 (2.0)	4.7 (3.2)	2.0 (1.6)
Azariq XVI (100–91)	Epipaleolithic	43.2 (13.5)	14.7 (4.5)	4.0 (1.5)	5.5 (2.6)	1.8 (1.0)
Fazael IIIA (100–92)	Early Epipaleolithic	31.3 (9.4)	7.8 (3.0)	3.0 (1.3)	3.8 (2.0)	1.4 (0.7)
Fazael IIIB (100–98)	Early Epipaleolithic	37.4 (13.0)	11.2 (3.8)	3.9 (1.5)	4.5 (2.2)	1.7 (1.6)
Shunera XVI (100–99)	Late Upper Paleolithic	39.2 (18.6)	11.5 (6.3)	3.8 (2.6)	6 (4.5)	2.3 (1.7)
Azariq XIII (100–76)	Late Upper Paleolithic	35.7 (10.1)	9.5 (3.9)	3.2 (1.7)	3.8 (2.6)	1.3 (0.7)
Hayonim D (100–97)	Early Upper Paleolithic	39.4 (15.8)	12.9 (6.5)	4.5 (2.9)	6.5 (4.7)	2.9 (5.8)
Qadis IV (100–96)	Early Upper Paleolithic	48.9 (12.6)	13.2 (4.3)	4.5 (2.1)	4.7 (2.2)	1.7 (0.9)
Qafzeh 13 (100)	Later Middle Paleolithic	60.9 (17.6)	22.7 (6.8)	7.0 (2.8)	14.9 (5.9)	5.1 (2.7)
Tabun I (71–70)	Interglacial Middle Paleolithic	64.2 (17.5)	22.6 (7.4)	7.1 (3.3)	15.3 (7.6)	4.9 (2.3)
Tabun IX (89–86)	Early Middle Paleolithic	71.7 (15.2)	23.9 (4.9)	7.2 (2.5)	17.4 (7.7)	5.8 (2.8)
Tabun XI (85–82)	Early Middle Paleolithic/ Late Lower Paleolithic	63.2 (16.3)	22.6 (6.3)	8.3 (3.0)	14.9 (5.9)	5.9 (3.3)

Note: Maximum number of observations refers to flake length, width, thickness. Minimum refers to striking platform measurements.

stone tool typology has an overtly functional character. Projectile points, knives, celts, and various kinds of groundstone tools (e.g., grinding slabs, querns, mortars, and pestles) are all defined in part on the basis of how archaeologists think they were used. Although there is always a risk of equating the typological structure we impose on this Neolithic record with the actual underlying structure of Neolithic functional variability, in this case the equation has some general support. Microwear studies show variation in tool motions and in contact materials among nearly every category of Neolithic tools examined, but they are remarkably consistent in showing on what part(s) of these tools use was concentrated. If we accept this more general definition of function-pattern in the observed use-wear and retouch (rather than inferred combinations of tool motions and worked materials), then Neolithic tools appear more functionally specialized than their Paleolithic counterparts.

Many Neolithic projectile points, knives, and sickle inserts feature extensive patterns of parallel scarring, most likely from pressure flaking. Neolithic celts are often extensively polished as well. In many cases, this scarring and polishing covers the entire surface of the tool, including parts that would have been enclosed in a handle during use and/or parts that were not active cutting edges. This "overdesign" adds little to tool functionality, and it comes at a considerable cost. Pressure flaking and polishing remove less raw material mass per unit of time and/or energy than any other method of controlled conchoidal fracture. Some measure of the scale of these cost differences are illustrated in Figure 8.5, which compares examples of functionally analogous Epipaleolithic versus Neolithic tools, projectile armatures, knives, sickle inserts, and celts. Juxtaposed with each artifact are estimates of the amount of time it takes the author, an experienced flintknapper, to produce reproductions of these artifacts. Neolithic projectile armatures take between 6 and 8 times longer to knap than Epipaleolithic ones, knives 15–20 times longer, Neolithic sickle inserts 3–5 times longer, and Neolithic flaked and partially polished celts 4–12 times longer. The difference between Epipaleolithic and Neolithic celts would be even greater if the Neolithic celt was a groundstone type. These artifacts can require between four and twenty-five hours of labor by a knapper skilled in their production (Toth, Clark, and Ligabue 1992, L. Kinsella, pers. comm.). Producing more complex Neolithic artifacts

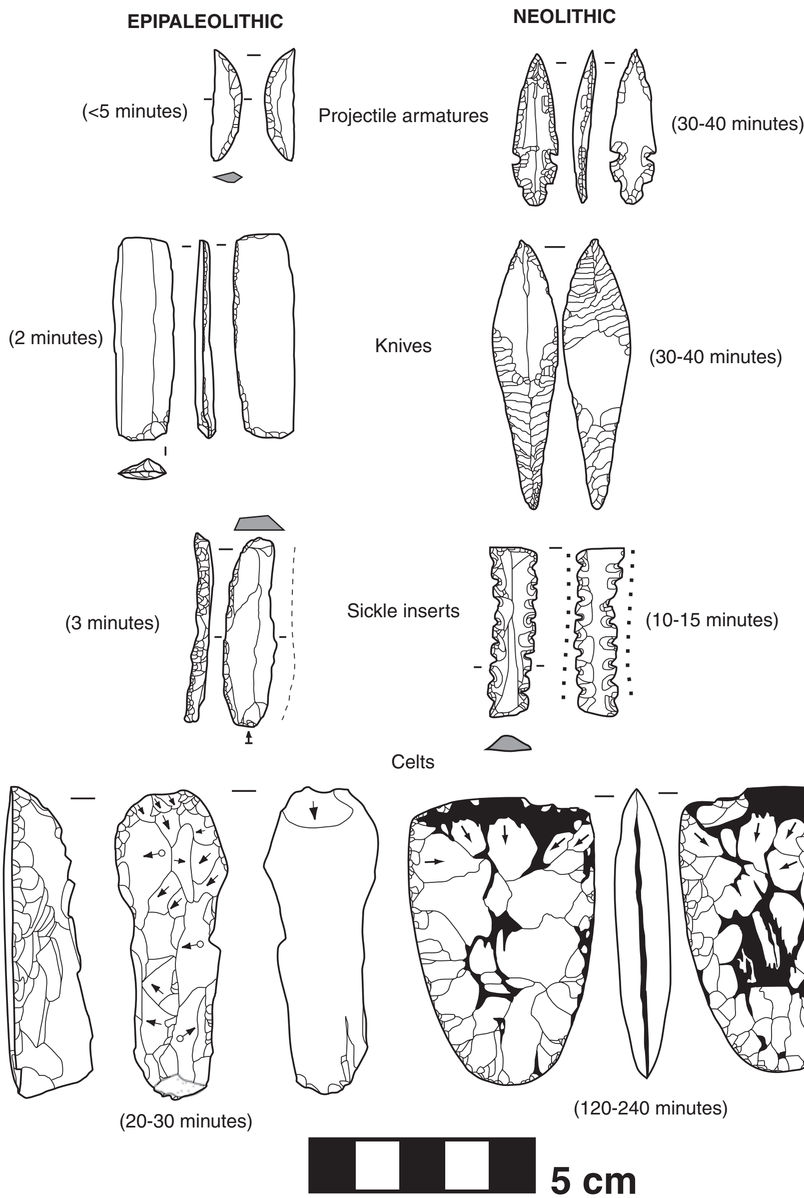


FIGURE 8.5. Estimates of the amount of time needed to reproduce functionally analogous Epipaleolithic and Neolithic stone tools.

required several orders of magnitude more time than their Epipaleolithic counterparts to no obvious mechanical/functional advantage. It is difficult to think of a clearer case of intensification, of increased energy expenditure, for the same or diminished reward, or how such a reallocation of time away from tasks more central to subsistence and reproduction could possibly persist other than in the context of adaptive strategies increasingly dependent on stone tool technology.

Overdesign is so pervasive and long-lasting a phenomenon among Neolithic stone tools that it has to have been the result of strong and stable selective pressure. One likely source for this selective pressure is our species' capacity for using exosomatic symbols (Deacon 1997, Gamble 2007). Unlike other tool-using primates, we humans use artifacts invested with shared symbolic meanings in our social interactions. In fact, we encounter strangers and other non-kin so regularly that we *have* to use symbolic artifacts to overcome the linguistic and cultural differences that divide us. Exosomatic symbol use long predates the Neolithic Period, as seen in Paleolithic use of mineral pigments, personal adornments, and both figurative and abstract art. What is particularly interesting about Neolithic symbolic overdesign is that it is being applied so obviously to everyday utilitarian lithic artifacts. Artifacts invested with symbolic meaning broadcast their messages continuously (Wobst 1977). Applying these symbolic overdesigns to utilitarian Neolithic artifacts can only make sense (and yield benefits proportionate to the outlays of production effort) in the context of adaptations involving recurrent and obligatory stone tool use. This inferred shift toward an increasingly social-symbolic role for lithic artifacts is paralleled by other dimensions of the Neolithic record, such as increasingly complex architecture, sculpture, ceramic decoration, and the systematic production of beads and other personal adornments (Kuijt 2002, Simmons 2007).

Epipaleolithic and Neolithic groundstone tools preserve even greater evidence of increased time and energy investment, and of human dependence, than flaked stone tools do. Even the simplest groundstone tools require orders of magnitude more production time than the most complex flaked-stone artifacts of equivalent antiquity. Groundstone tools increase from relatively low frequencies (less than 33 percent) among Upper Paleolithic and Early-Middle Epipaleolithic assemblages to near-ubiquity (more than 70 percent) in Later

Epipaleolithic and Neolithic assemblages (Wright 1991, 1993, 1994) (see Table 8.5). Neolithic groundstone tools and installations are not only more common than Epipaleolithic installations, they are also overdesigned (see previous discussion) and their upper size limit is greater. This latter quality suggests Neolithic humans had developed a greater tolerance for previously prohibitive transport costs. These developments in groundstone technology are further consistent with a hypothesis of increased tool dependence in Neolithic times.

III. THE LEVANTINE LITHIC RECORD IN PERSPECTIVE

As prehistoric archaeology grew in the late nineteenth and early twentieth centuries, the "Stone Age" was divided into Neolithic and Paleolithic periods. The chronostratigraphic break between these periods corresponded roughly with the transition between Holocene/Postglacial and Pleistocene/Ice Ages. An "Eolithic" Period, during which stone tools differed little from naturally broken forms, stretched back into pre-glacial antiquity. (The fortunes of the Eolithic as a recognized archaeological period declined as archaeology developed more scientific methods for identifying human agency in stone tool production (Grayson 1986).) Today, we know the broad geochronological outlines of these Paleolithic and Neolithic periods, and our knowledge about the patterns of stone tool production and use that characterize them is steadily growing.

In considering the Levantine Stone Age record in a broader perspective, it is worth remembering the nineteenth-century origins of our current chronostratigraphic frameworks. These frameworks were developed in Europe to solve basic problems in correlating stratigraphy across imprecisely dated sites. They were not intended, originally at least, to serve as models for hominin behavioral evolution, although over time they were adapted to that purpose. As our knowledge about Paleolithic and Neolithic behavioral variability has grown, both from an increased archaeological database as well as from improvements in analytical methods for studying stone tools and other residues, the Paleolithic-Neolithic framework is showing its age. This work structured its discussion of the lithic evidence around the conventional divisions of the Paleolithic and Neolithic because this is how the published archaeological literature is structured. Future editions of

Table 8.5. *Occurrences of Groundstone Tools in Later Pleistocene and Early Holocene Contexts*

Period(n assem-blages)	%AWGS	Quern	Mortar	Pestle	Stone Vessel	Grooved Stone	Perforated Stone	Celt	GS(n)
Upper Pale-olithic (62)	26	44	0	6	0	6	0	0	35
Early Epipale-olithic (78)	15	17	33	25	8	8	8	0	25
Middle Epipale-olithic (178)	15	15	30	19	26	0	0	4	57
Early-Middle Natufian (35)	49	18	59	59	35	35	18	6	683
Late Natufian (47)	49	39	65	39	26	30	9	0	779
Harifian (10)	100	20	30	30	10	70	20	0	243
PPNA (24)	71	65	59	59	47	24	0	24	834
Early-Middle PPNB (31)	94	55	24	38	52	38	24	31	3094
Late-Final PPNB (44)	70	58	26	29	55	32	32	39	4058
Ceramic Neolithic (60)	72	49	23	21	44	21	35	33	466

Notes: Columns indicate percentages of assemblages from each period with groundstone tools present showing evidence of particular groundstone artifact categories. *Sources:* Wright (1993, 1994). %AWGS = Assemblages with groundstone tools present divided by the number of assemblages surveyed. GS(n) = number of groundstone tools.

this book, or its successors as guides to the lithic evidence, will almost certainly be structured differently.

In my view, the Lower Paleolithic could be more meaningfully subdivided than it is, as it encompasses a vast period of time. There are almost certainly major diachronic shifts in hominin behavior and in behavioral variability lurking undetected among Lower Paleolithic stone tools. In contrast, one sees little if any continued justification for forcing a major chronostratigraphic break between the Upper Paleolithic and the Epipaleolithic. There are far more continuities between the lithic evidenced for these periods than there are differences. The Lower-Middle Paleolithic "transition" in the Levant appears particularly sharp, and one suspects this distinction actually captures some major shift in lithic technology and associated hominin behavior. On the other hand, the lithic basis for distinguishing between Middle and early Upper Paleolithic and between Epipaleolithic and the early Neolithic (PPNA) are not well enough documented at present to predict their continued value. They do not mark a major additive shift in lithic technology, but as noted at the outset of this work, there is more to prehistory than lithics. If anything, the difference between the earliest Neolithic (PPNA) and subsequent PPNB/C and Later Neolithic phases seems particularly worthy of greater emphasis (at least in the southern Levant) than is currently the case.

In looking back over the countless named artifact-types and dozens of named stone tool industries that populate the Stone Age prehistory of the Levant, it is important to remember that this evidence is first and foremost a record of change and variability in tool making habits and that the nature of these habits evolved over time. That is to say the calculus of cost and benefit influencing lithic technology changed constantly. Earliest evidence for stone tool production currently dates to around 2.6 Ma, although the habit of using stones as tools almost certainly has a greater antiquity than this (Plummer 2004). The sparse nature of the oldest archaeological finds and the superficial degree to which the oldest stone tools have been modified suggests earlier Pleistocene hominins were likely occasional, rather than habitual or obligatory tool-users. Pebble-core technology was almost certainly invented, abandoned, and rediscovered countless times. The first signs of habitual stone tool use, of hominins using stone tools on a regular basis are widely shared patterns in the ways that arbitrary shapes are imposed on stone tools. Archaeological opinion differs over whether variants of Acheulian LCT production fit the criteria for such technological traditions or whether variable lithic operational sequences of Middle Paleolithic antiquity better fit the bill. This patterning plausibly reflects learned patterns of tool use, something similar to the social and inter-generational transfer of technical knowledge we see among recent humans. By Upper Paleolithic times, the use of stone tools for such essential tasks as hunting (projectile points) and the production of leather for clothing (endscrapers), and rudimentary architecture signals the arrival of obligatory tool use. Subsequent inflections in the lithic record signal shifts toward ever-greater stone tool dependence. Later phases of Stone Age prehistory witness stone tools being recruited into service as exosomatic symbols, either passively – as one can plausibly infer for broad patterns of shared microlithic tool design in the Epipaleolithic, or more assertively as one can see in the extensive decorative pressure flaking of Neolithic knives and projectile points, and in the polishing and decorative carving on many groundstone tools.

Along with chronicling increased stone tool dependence, the Levantine lithic record also shows a record of increasing behavioral variability – the ability to maintain and to use more than one solution to any given set of problems. The chief evidence of this trend is that few techniques of stone tool production are ever abandoned. It is true that certain named morphological artifact-types come and go in the Levantine lithic record (e.g., Acheulian cleavers, Levallois points), but much of this pattern reflects differences in the systematics used by archaeologists for different periods of Stone Age prehistory. Basic techniques of stone tool production (e.g., hard- and soft-hammer percussion, pressure-flaking, and edge-grinding/polishing) were only abandoned after metal tools became regularly available in the Iron Age. Behavioral variability and obligatory tool-use are two of the most important legacies of our Stone Age past.

Few of the Levant's recent inhabitants habitually make stone tools today (Whittaker, Kamp, and Yilmaz 2009). Nevertheless, there, as in many parts of the world, stone tool technology lurks in the background, ready to be deployed. Writing of his service in Arabia during the First World War, T. E. Lawrence (1935: 294) wrote:

> We put a few miles between us and the railway before we sat down to our feast of mutton. We were short of knives, and, after killing the sheep in relay, had recourse to stray flints to cut them up. As men unaccustomed to such expedients, we used them in the eolithic spirit; and it came to me that if iron had been constantly rare we should have chipped our daily tools skillfully as palaeoliths: whilst had we had no metal whatever, our art would have been lavished on perfect and polished stones.

Stone tools are the common heritage of all humanity. No other animal has ever made so much and so varied use of any technology as humans have with stone tools. Few of us depend on stone tools today, but is a comforting thought that when we again have need of stone artifacts, they will be there, patiently waiting for us to return our attention to them.

APPENDIX 1

Artifact-Type Lists

This Appendix presents checklists of artifact-types. Table A1.1 is for use with lithic assemblages of any period. Table A1.2 combines Lower and Middle Paleolithic artifact-types. Table A1.3 combines Upper Paleolithic and Epipaleolithic artifact-types. Neolithic artifact-types are listed in Table A1.4. These tables are organized hierarchically by column. The right-most column lists major artifact categories, the next column lists specific artifact types, the next lists sub-types. With a few exceptions, the lists for successive periods are non-cumulative. That is, artifact-types common to all periods listed in Table A1.1 are not repeated in the type-lists for later periods. For the sake of brevity, these lists also omit the residual "other," "miscellaneous," and "indeterminate" categories

LOWER AND MIDDLE PALEOLITHIC TYPE-LIST

The type-list for Levantine Lower and Middle Paleolithic contexts was compiled from typologies published by M. Leakey (1971), F. Bordes (1961), and A. Debénath and H. Dibble (1994).

UPPER PALEOLITHIC AND EPIPALEOLITHIC TYPE-LIST

This type-list for the Upper Paleolithic and Epipaleolithic Periods combines the typologies generated by the 1969 London conference on Levantine Paleolithic typology (Hours 1974) with those published by Bar-Yosef (1970) and Goring Morris (1987).

Table A1.1. *Artifact-Types Found in Multiple Periods*

No.	Major Category	Types
1	Pounded Pieces	Hammerstone
2		Anvil
3	Cores	Inclined core
4		Parallel core
5		Platform core
6		Core-on-flake
7	Débitage	Cobble/pebble fragments
8		Cortical flake
9		Non-cortical flake
10		Core-trimming flake
11		Blade
12		Prismatic blade
13		Proximal flake fragment
14		Non-proximal flake fragment
15		Debris
16	Retouched Tools	Scraper
17		Truncation
18		Backed knife
19		Awl/Perforator
20		Point
21		Limace
22		Notch
23		Multiple Notch
24		Denticulate
25		Scaled piece
26		Foliate point*

Note: Foliate points are extremely rare in Paleolithic contexts.

NEOLITHIC TYPE LIST

This list combines type-lists used by several different researchers, Nadel's (1997) framework for Netiv Hagdud, Gopher's (1994) for projectile points, Barkai's (2005) for celts, M. C. Cauvin's (1983) for sickle inserts, and Kozlowski's and Aurenche's (2005) for various other artifacts. Typological distinctions among groundstone tools follow Wright (1992).

Table A1.2. *Lower and Middle Paleolithic Artifact-Types*

No.	Category	Major Types	Minor Types
1	Pounded Pieces	Subspheroid	
2		Spheroid	
3	Pebble Cores	Choppers	Unifacial chopper
4			Bifacial chopper
5			Core-scraper
6		Discoids	Symmetrical discoid
7			Asymmetrical discoid
8		Polyhedron	
9		Prismatic core	
10		Giant core	
11		Levallois cores	Preferential Levallois core
12			Recurrent Levallois core
13		Nahr Ibrahim core (core-on-flake)	
14	Large Cutting Tools	Picks	Pick
15			Trihedral pick
16			Quadrihedral pick
17		Thick handaxes	Lanceolate biface
18			Ficron biface
19			Micoquian biface
20			Amygdaloid biface
21			Abbevillian biface
22			Protobiface/elongated discoid
23		Flat Handaxes	Triangular biface
24			Elongated triangular biface
25			Cordiform biface
26			Elongated cordiform biface
27			Subcordiform biface
28			Ovate biface
29			Discoidal biface
30			Elongated oval biface (limande)
31			Lozenge-shaped biface
32		Thick-or-Flat Handaxes	Bottle-shaped (lagéniforme) biface
33			Arch-shaped (naviforme) biface

(*continued*)

Table A1.2 (*continued*)

No.	Category	Major Types	Minor Types
34			Core-shaped biface
35			Partial biface
36		Cleavers	Biface cleaver
37			Cleaver on flake
38		Massive scraper	
39	Débitage	LCT-related flakes	Biface tip-removal flake
40			Biface thinning flake
41			Biface overshot flake
42		Levallois flakes	Levallois flake
43			Levallois blade
44			Levallois point
45			Elongated Levallois point
46			Levallois core-trimming elements
47		Other flakes	Naturally backed knife
48			Blade
49			Prismatic blade
50			Janus/Kombewa flake
51			Asymmetrical (Pseudo-Levallois) point
52			Burin spall
53	Retouched Tools	Single & transverse Scrapers	Single straight scraper
54			Single convex scraper
55			Single concave scraper
56			Straight transverse scraper
57			Convex transverse scraper
58			Concave transverse scraper
59			Typical endscraper
60			Atypical endscraper
61		Double scrapers	Double straight scraper
62			Double straight-convex scraper
63			Double straight-concave scraper
64			Double convex scraper
65			Double concave scraper
66			Double convex-concave scraper
67		Convergent scrapers	Straight convergent scraper
68			Convex convergent scraper

No.	Category	Major Types	Minor Types
69			Concave convergent scraper
70			Déjeté (canted) scraper
71		Other scraper types	Yabrudian scraper
72			Scraper on interior (ventral) surface
73			Abrupt (steeply retouched) scraper
77			Scraper with thinned back
75			Bifacial scraper
76			Alternate scraper
77		Points	Awl/Perforator
78			Tayac point
79			Retouched Levallois point
80			Mousterian point
81			Elongated Mousterian point (Abu Sif knife)
82			Limace
83		Burins	Symmetrical burin
88			Asymmetrical burin
85		Backed knives	Symmetrical backed knife
86			Asymmetrical backed knife
87		Truncation	
88		Notch	
89		Denticulate	

Table A1.3. *Type-List for the Upper Paleolithic and Epipaleolithic Periods*

No.	Artifact Category	Major Type	Minor Types
1	Pounded Pieces	Hammerstone	
2	Cores	Blade core	
3		Bladelet core	
4		Discoid	
5		Polyhedral core	
6	Débitage	Blade	
7		Bladelet	
8		Microblade	

(*continued*)

Table A1.3 (*continued*)

No.	Artifact Category	Major Type	Minor Types
9		Plunging/overshot blade	
10		Core-tablet flake	
11		Crested blade	
12	Retouched Tools	Scrapers	Single (symmetrical) endscraper
13			Atypical (asymmetrical) endscraper
14			Double flat endscraper
15			Ogival endscraper
16			Endscraper on "Aurignacian" blade
17			Fan-shaped/Transversal endscraper
18			Endscraper on a Levallois point
19			Circular (end)scraper
20			Thumbnail endscraper
21			Flake scraper
22			Denticulated scraper/Ksar Akil scraper
23		Carinated Pieces	Carinated endscraper
24			Broad carinated scraper on thick flake
25			Narrow carinated scraper
26			Lateral carinated endscraper
27			Thick-nosed endscraper
28			Flat-nosed or shouldered endscraper
29			Micro-carinated endscraper
30			Multiple carinated endscraper
31			Thick endscraper on a core (core-scraper).
32		Burins	Straight dihedral burin
33			Offset dihedral burin
34			Angle dihedral burin
35			Dihedral burin on break

No.	Artifact Category	Major Type	Minor Types
36			Multiple dihedral burin
37			Beaked burin
38			Carinated burin
39			Flat-faced carinated burin
40			Right angle straight truncation burin
41			Burin on a straight oblique truncation
42			Burin on a concave truncation
43			Burin on a convex truncation
44			Burin on a lateral preparation
45			Oblique burin on a lateral preparation
46			Transverse burin on a lateral preparation
47			Transverse burin on a notch
48			Multiple burin on a truncation
49			Mixed multiple burin
50			Burin on a Levallois point
51		Chamfered pieces	Chamfered piece on lateral preparation
52			Chamfered piece on a notch
53			Oblique chamfered piece on truncation
54			Multiple chamfered piece
55		Backed knives/ blades	Knife with a curved back
56			Knife with a straight back
57			Piece with an irregular back
58			Piece with two backed edges
59			Partially-backed piece
60			Helwan blade
61			Shouldered piece
62			Backed fragment
63		Truncations	Flake with straight truncation
64			Blade with straight truncation

(*continued*)

Table A1.3 (*continued*)

No.	Artifact Category	Major Type	Minor Types
65			Piece with convex truncation
66			Piece with oblique truncation
67			Piece with concave truncation
68			Bitruncated piece
69			Backed and truncated piece
70		Retouched flakes & blades	Flake with continuous retouch
71			Blade with continuous retouch on one edge
72			Blade with continuous retouch on lateral edges
73			Aurignacian blade
74			Strangled blade or blade with a wide notch
75			Piece with inverse or alternate retouch
76		Notches & denticulates	Piece with a large (>5 mm) notch
77			Piece with a small (≤5 mm) notch
78			Piece with two or more notches
79			Denticulate
80			Alternate burinated bec
81		Awl/perforators	Awl
82			Perforators
83			Heavy perforator/Borer
84			Micro-perforator
85			Multiple perforator
86		Combination tools	Endscraper/sidescraper
87			Flat endscraper-burin
88			Carinated endscraper-burin
89			Endscraper/truncated piece
90			Burin-truncated piece
91			Perforator-truncated piece
92			Perforator-endscraper
93			Perforator-burin
94			Other combinations
95		Microburin technique	Microburin

No.	Artifact Category	Major Type	Minor Types
96			Krukowski microburin
97			Trihedral pick (piquant trièdre)
98			Backed bladelet with trihedral pick (piquant trièdre)
99		Non-geometric microliths	Pointed bladelet with fine retouch
100			Blunt bladelet with fine retouch
101			Bladelet with curved back
102			Pointed bladelet with abrupt retouch (Dufour bladelet)
103			Blunt bladelet with abrupt retouch
104			Bladelet with back curved by abrupt retouch
105			Short bladelet with back curved by abrupt retouch
106			Bladelet with inverse retouch
107			Bladelet with alternate retouch
108			Microgravette
109			Bladelet with Helwan retouch
110			Bladelet with Barajné retouch
111			Truncated bladelet
112			Backed and truncated bladelet
113			Backed bladelet with alternate truncation
114			Backed bladelet with a truncation forming an acute angle or point
115			Shouldered bladelet
116			Bladelet with partial fine retouch
117			Bladelet with complete fine retouch
118			Partially-retouched bladelet
119			Completely-retouched bladelet
120			Bladelet retouched on both edges
121			Blunt backed bladelet (including splayed)
122			Pointed backed bladelet

(*continued*)

Table A1.3 (*continued*)

No.	Artifact Category	Major Type	Minor Types
123			Pointed backed bladelet with basal modification
124			Curved pointed bladelet
125			Micropoint
126			Micropoint with basal modification
127			Obliquely truncated bladelet (Jiita point or Kebara point)
128			Obliquely-truncated and backed bladelet
129			Scalene bladelet
130			Scalene bladelet with basal modification
131			Arch backed bladelet
132			Arch backed bladelet with basal modification
133			Retouched /backed fragments
134		Geometric microliths	Bitruncated bladelet
135			Straight truncated and backed
136			Narrow backed and bitruncated bladelet
137			Parallelogram
138			Proto-trapeze
139			Trapeze
140			Asymmetric trapeze A
141			Asymmetric trapeze B
142			Trapeze with one convex end
143			Trapezoid-rectangle with broken end
144			Truncated triangle
145			Trapezoid-rectangle with Helwan retouch
146			Isosceles triangle
147			Scalene triangle
148			Elongated scalene triangle with abrupt retouch
149			Elongated scalene triangle with Helwan retouch

No.	Artifact Category	Major Type	Minor Types
150			Atypical triangle
151			Proto-triangle
152			Triangle with Barajné retouch
153			Lunate
154			Atypical lunate
155			Lunate with Helwan retouch
156		Points	Emireh point
157			Umm el Tlel point
158			Ksar Akil point
159			El-Wad point
160			Falita point
161			Shunera point
162			Proto-Harif point
163			Harif point
164			Ounan point
165			Khiam point
166			Abu Madi point
167			La Mouillah point
168			La Mouillah point with basal modification
169			Ramon point
170			Ramon point with basal modification
171			Atypical Ramon point
172			Helwan point
173			Double-truncated Helwan point
174		Sickle-blades	Unretouched sickle blade
175			Sickle blade on backed blade or bladelet
176			Sickle blade on curved backed blade
177			Sickle blade on Helwan blade or bladelet
178		Large retouched tools	Chisel/retoucher
179			Pick/chopping tool
180			Massive denticulate
181			Massive battered piece

(*continued*)

Table A1.3 (*continued*)

No.	Artifact Category	Major Type	Minor Types
182			Massive scraper
183			Massive burin
184	Groundstone	Pulverizing equipment	Grinding slab/quern
185			Portable mortar
186			Bedrock mortar
187			Handstone
188			Pitted handstone
189			Pestle
190		Carved Stones	Concave stone
191			Grooved stone
192			Incised stone/pebble
193			Perforated stone
194		Stone vessels	Platter
195			Bowl

Table A1.4. *Type-List for the Neolithic Period*

No.	Technological Category	Major Type-Groups	Specific Types
1	Cores	Flake Cores	Single platform unidirectional flake core
2			Single platform discoidal flake core/discoid
3			Parallel-opposed double platform flake core
4			Perpendicular-opposed double platform flake core
5			Multiple-platform flake core
6			Pebble core
7			Elongated flake core (roughout)
8		Blade Cores	Unidirectional -pyramidal or sub-Pyramidal Blade Core
9			Bullet-shaped blade core
10			Bipolar bidirectional blade core
11			Postero-lateral bidirectional blade core
12			Naviform bidirectional blade core
13		Other cores	Tested cobble or pebble

No.	Technological Category	Major Type-Groups	Specific Types
14	Unretouched flakes	Flakes	Cortical flakes
15			Noncortical flake
16		Biface flakes	Biface shaping/thinning flake
17		Blades	Pointed central blade
18			Bidirectional central blade (upsilon blade)
19			Other central blade
20			Blades with cortical or steep edges
21		Core-trimming elements	Blade-core repair/rejuvenation flake
22			Bidirectional blade/distal core trimming flake.
23			Crested blade
24			Overshot blade/flake
25			Core tablet flake
26			Tranchet flake
27	Pounded Pieces	Ad hoc hammerstones	Percussor (ad-hoc hammerstone)
28			Firestone
29			Retoucher
30		Shaped hammerstones	Facetted stone
31			Stone ball
32	Core-Tools	Large core tools	Pick
33			Heavy-duty tool
34		Flaked-stone celts	Axe
35			Adze
36			Chisel
37			Miniature celt
38	Projectile points	Harifian points	Harif point
39			Ounan point
40			Shunera point
41		South Levant Early Neolithic types	el-Khiam point (sensu stricto)
42			Salibiya point

(*continued*)

Table A1.4 (*continued*)

No.	Technological Category	Major Type-Groups	Specific Types
43			Jordan Valley point
44			Abu Maadi point
45		North Levant Early Neolithic types	Güzir point
46			Qaramel point
47			Nemrik point
48			Demirköy point
49			Jerf el-Ahmar point
50			Nevali Çori point
51			Mureybit point
52		Helwan points	Sheikh Hassan point
53			Aswad point
54			Abu Salem point
55		Elongated points	Jericho point
56			Byblos point
57			Amuq point
58			Intermediate Jericho-Byblos point
59			Intermediate Byblos-Amuq point
60		Short Later Neolithic points	Ha-Parsa point
61			Nizzanim point
62			Herzliya point
63		Segmented pieces	Transverse arrowhead
64	Knives	Large projectile points/knives	Large Amuq point
65			Large Byblos point
66			Large Jericho point
67		Knives on blades	Blade with backing or marginal retouch
68			Beit Tamir knife
69			Blade with retouched point and/or base
70			Nahal Hemar Knife
71		Bifacial knives	Bifacial knives
72			Partly-bifacial knives
73		Tabular knives	Ashkelon knife
74	Sickle Inserts	Sickle inserts made on blades (Type A)	A1. Polished unretouched blade

No.	Technological Category	Major Type-Groups	Specific Types
75			A2. Polished straight-backed blade
76			A3. Blade with small-scale denticulation on polished edge.
77			A4. Blade with large-scale denticulation on polished edge.
78			A5. Polished blade with basal modification or a retouched tang.
79			A6. Blade with two polished lateral edges.
80		Sickles inserts made from flakes or flake/ blade fragments (Type B)	B1. Polished unretouched flake
81			B2. Polished piece with backed edge.
82			B3. Polished piece with bifacial-backing (Beit Tamir knife/sickle)
83			B4. Polished piece with large-scale denticulation
84			B5. Polished piece with flat invasive retouch
85			B6. Polished piece with a curved back
86	Retouched flakes/ blades	Scrapers	Single endscraper on blade
87			Double endscraper on blade
88			Thumbnail scraper
89			Tabular/cortical scraper
90			Scraper on flake
91		Perforators	Awl
92			Bec
93			Borer
94			Drill bit
95			Micro-perforator/épine
96		Burins	Single transverse burin
97			Single burin on natural break
98			Single burin on truncation
99			Dihedral burin

(*continued*)

Table A1.4 (*continued*)

No.	Technological Category	Major Type-Groups	Specific Types
100			Double burin
101			Multiple burin
102			Other burin
103		Denticulates, notches	Notched flake/blade
104			Double notched flake/blade
105			Multiple-notched flake/blade
106			Denticulate flake/blade
107			Gilgal truncation
108		Backed, Truncated Pieces	Backed flake/blade
109			Partially-backed flake/blade
110			Truncated flake/blade
111			Truncated and backed flake/blade
112			HaGdud truncation
113			Double-backed blade/Çayonü knife
114		Multiple Tools	Combinations of scraper, perforator, burin, denticulate, etc.
115		Varia	Other retouched tools
116	Groundstone Tools	Groundstone Celts/Axes	Oval thick polished bifacial celt
117			Triangular polished bifacial celt
118			Polished bifacial celt with rectangular section
119			Pedunculated polished celt
120			Elongated/chisel-like celt
121			Perforated celt
122			Miniature polished celt
123		Pulverizing equipment	Grinding slab/quern
124			Shallow mortar
125			Deep mortar
126			Bedrock mortar
127			Combination grinding slab/quern/mortar
128			Handstone
129			Pitted handstone
130			Pestle
131			Polishing pebble
132		Carved Stone	Concave stone

No.	Technological Category	Major Type-Groups	Specific Types
133			Grooved stone
134			Incised stone/pebble
135		Perforated Stone	Pendant palette
136			Asymmetrical perforated stone
137			Symmetrical perforated stone sphere ("macehead")
138			Symmetrical perforated stone disk
139		Stone vessels	Platter
140			Bowl
141			Vessel with shaped base
142			Miniature vessel
143			Other vessel

APPENDIX 2

Measuring Lithic Artifacts

This Appendix discusses common measurements made on lithic artifacts. It is not an exhaustive list. Particular measurements vary among different time periods and with differences in research questions. Readers seeking further information on these topics should consult more extensive discussions in Inizan et al. (1999) and Brézillon (1977). All measurements discussed in this appendix are made in millimeters (mm).

I. CORES

Cores – Discrete Variables

For cores, many typologists record the following variables:

Cortex coverage is the proportion of the core surface covered by cortex. Digital image analysis can render such estimates with infinite precision, but for visual assessments, a three-part register of cortex coverage (Absent, $< 50\%$, $\geq 50\%$), is a good compromise between precision and ease of inter-observer replicability.

The count of the number of flake scars (>20 mm) does not discriminate between scars that preserve the impressions of whole or partial flake ventral surfaces.

For cores that have a single flake-release surface, such as parallel and platform cores, some lithic analysts record the directionality of flake scars. Classifications of scar directionality include the following (Figure A2.1a):

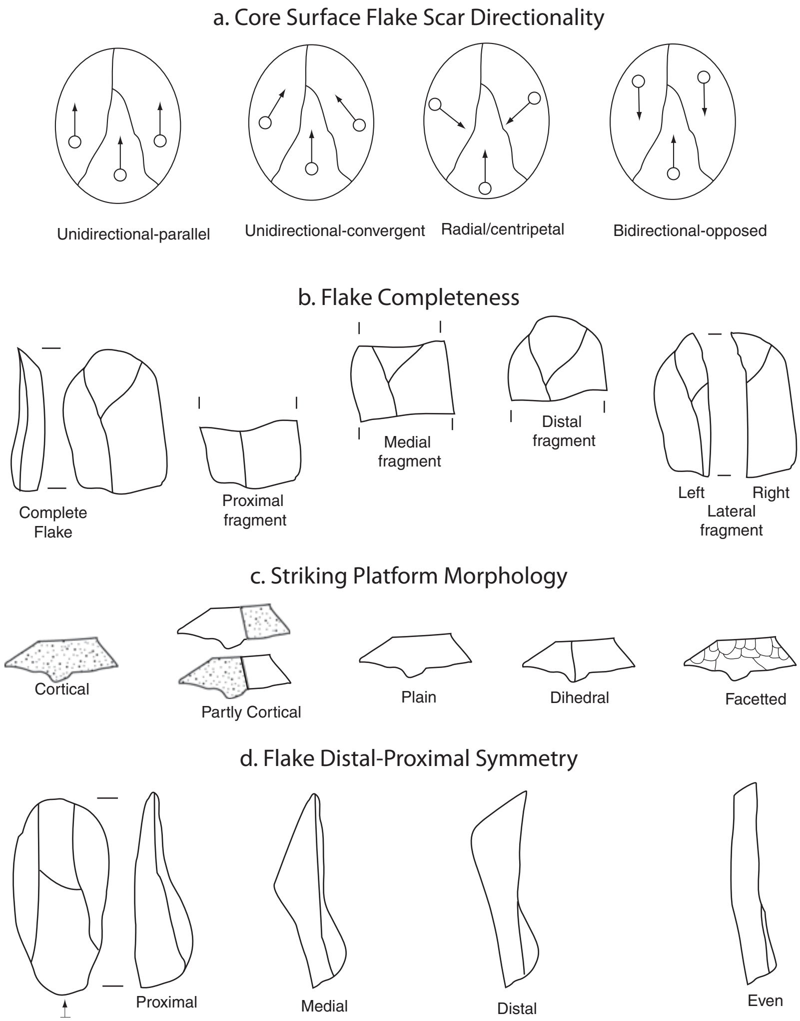


FIGURE A2.1. Artifact attributes template 1: a. core surface flake scar directionality, b. flake completeness, c. striking platform morphology, d. flake distal-proximal symmetry.

- *Unidirectional-Parallel* – scars are approximately parallel to each other
- *Unidirectional-Convergent* – scars converge at the distal end of the surface
- *Radial/Centripetal* – scars converge at the center of the flake-release surface

Table A2.1. *Indices used in LCT Typology (Debénath and Dibble 1994: 131)*

Index	Numerator	Denominator	Comment
Location of Maximum Width Index	Length	Distance from the base to the maximum width	
Edge Roundness Index	Width at midpoint of length	Maximum width	
Pointedness Index	Width at 75% of length	Maximum width	
Elongation Index	Length	Maximum width	
Flatness Index	Maximum width	Maximum thickness	If >2.35, the LCT is classified as "flat" (as opposed to "thick")

- *Bidirectional-Opposed* – scars converge toward one another's distal ends

Recently, several groups of researchers have proposed mechanically-assisted methods for measuring variation in individual scar directionality (Clarkson, Vinicius, and Lahr 2006; Lycett, von Cramon-Taubadel, and Foley 2006).

Cores – Continuous Variables

The most common measurements for cores include the following:

Length – the object's longest dimension

Width – the longest dimension perpendicular to length

Thickness – the longest dimension perpendicular to the plane defined by the intersection of length and width.

The following additional measurements are made on Lower Paleolithic large cutting tools (LCTs) (see Figure A2.2). These measurements are used to calculate a series of typological indices that serve as aids to LCT classification (see Table A2.1):

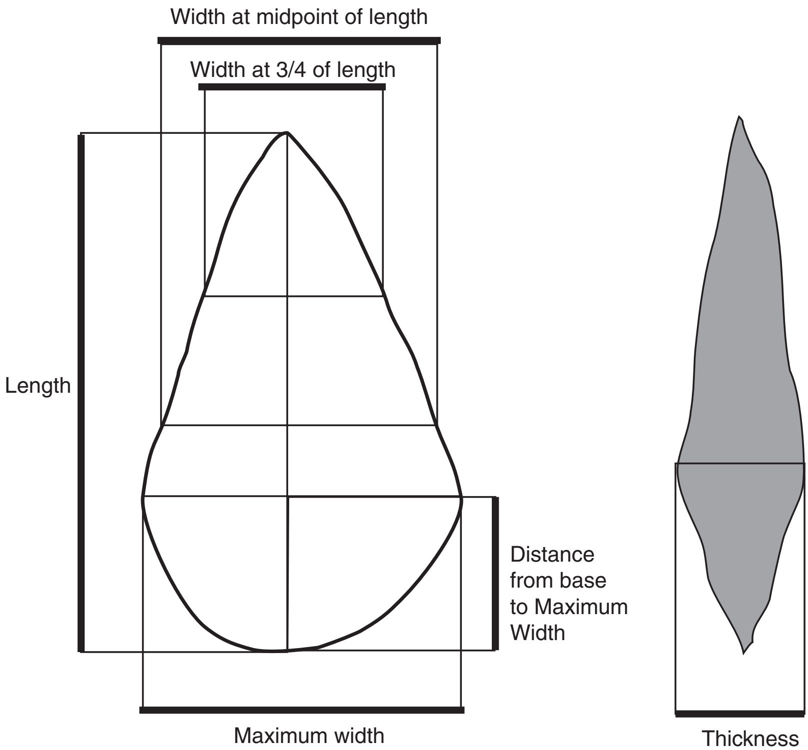


FIGURE A2.2. Measurements for LCTs.

Distance from the base to the maximum width along the length axis.

Width at midpoint of the length axis.

Width at three quarters of the length axis.

II. DÉBITAGE: FLAKES AND FLAKE FRAGMENTS

Archaeologists usually only measure flakes and flake fragments longer than 20–25 mm. Smaller artifacts lacking retouch are classified as debris and merely counted.

Débitage – Discrete Variables

Completeness and striking platform morphology are usually recorded for all flakes and flake fragments.

Completeness – whether or not the flake preserves striking platform, distal termination, and lateral edges (Figure A2.1b). The following are common classifications of flake completeness (Sullivan and Rozen 1985)

- *Complete Flake*
- *Proximal Flake Fragment*
- *Medial Flake Fragment*
- *Distal Flake Fragment*
- *Lateral Flake Fragment*

Striking Platform Morphology is classified according to a series of templates (Figure A2.1c).

- *Cortical* – cortex on 50% or more of the striking platform
- *Partly-cortical* – cortex less than 50% of the striking platform
- *Plain* – platform is a flat, planar surface
- *Facetted* – platform preserves numerous retouch scars
- *Dihedral* – platform is divided by one or more prominent ridges aligned dorso-ventrally

The following discrete variables are usually only recorded for complete flakes:

Cortex Extent is the extent of weathered cortical surface on the dorsal side of the flake. As with cores, the most efficient way to measure cortex extent as a discrete variable is by a three-part classification (Absent, $<50\%$, $\geq 50\%$).

Dorsal Surface Morphology – in comparison to a series of templates (Figure A2.3).

- *All Cortical*
- *Partially cortical-distal*
- *Partially cortical-right*
- *Partially cortical-left*
- *Relict edge-distal*
- *Relict edge-right*
- *Relict edge-left*
- *Relict edge-radial*
- *Unidirectional-parallel flake scars*
- *Unidirectional-convergent flake scars*

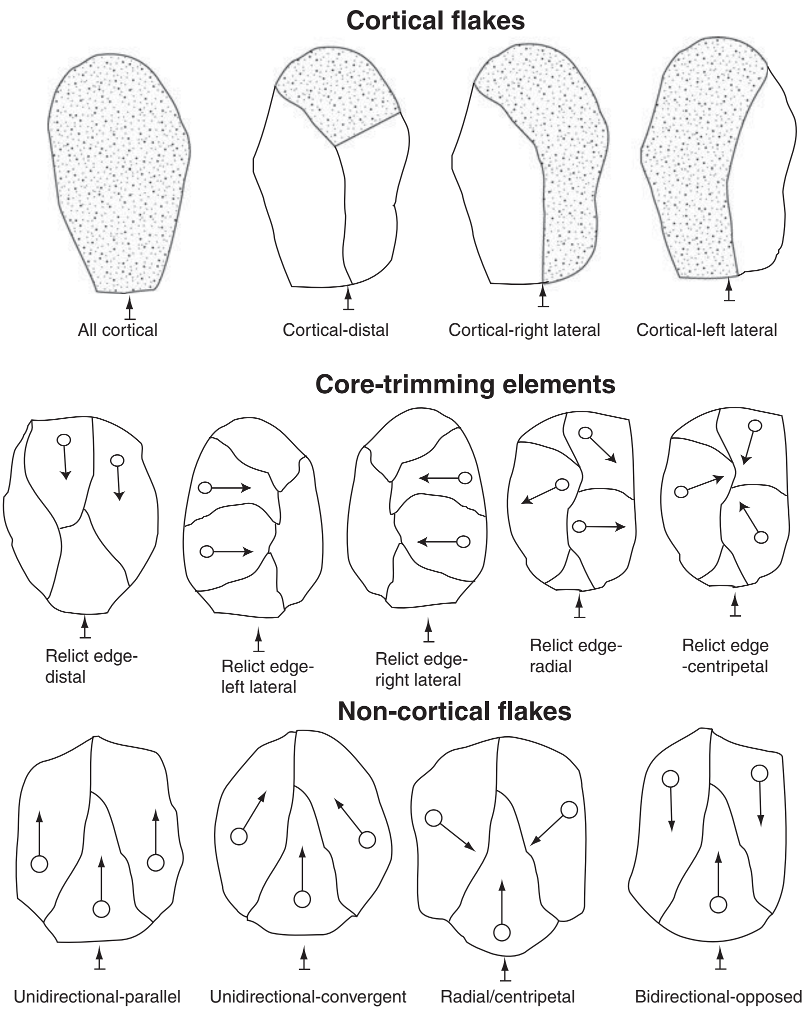


FIGURE A2.3. Dorsal surface morphology for cortical flakes, core-trimming elements, and non-cortical flakes.

- *Radial/centripetal flake scars*
- *Bidirectional-opposed flake scars*

Distal-Proximal Symmetry is the location of maximum thickness in the distal-proximal plane of the flake (Figure A2.1d).

- *Proximal* – thickest near the striking platform
- *Medial* – thickest at the midpoint of its length

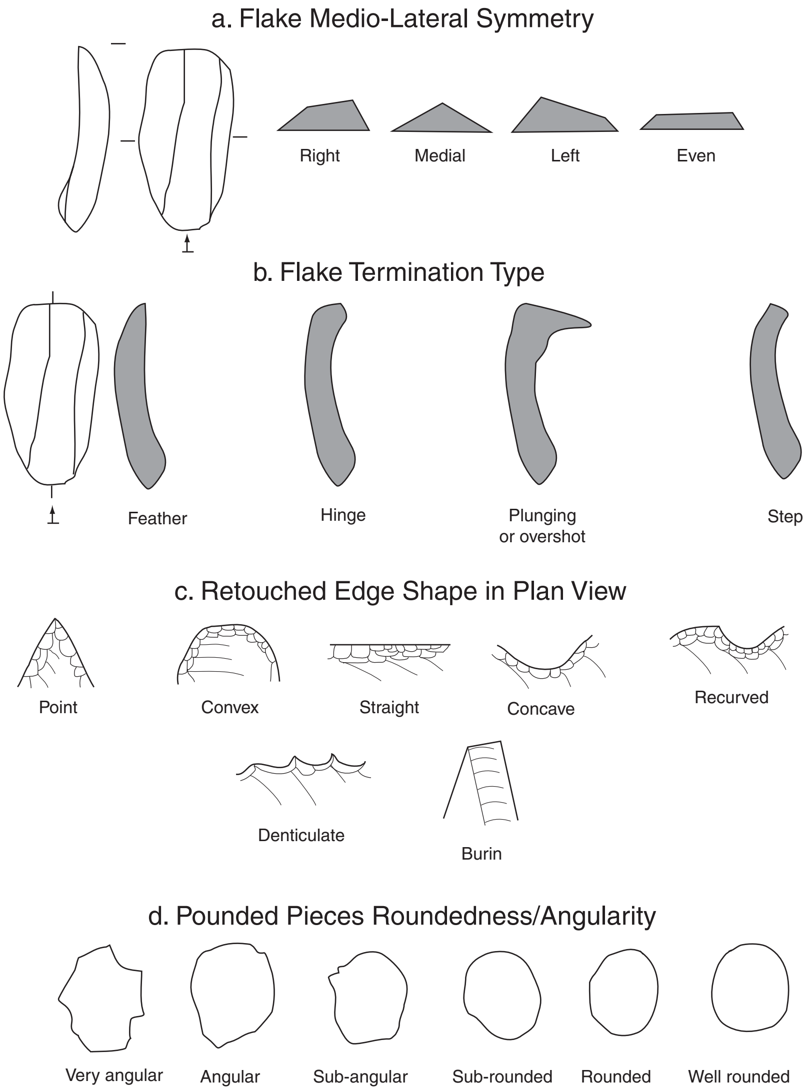


FIGURE A2.4. Artifact attributes template 2: a. flake medio-lateral symmetry, b. flake termination, c. retouched edge shape in plan view, d. pounded piece roundedness/angularity.

- *Distal* – thickest at the distal end
- *Even* – even thickness along its entire length

Medio-Lateral Symmetry is the location of maximum thickness in the medio-lateral plane of the flake (Figure A2.4a).

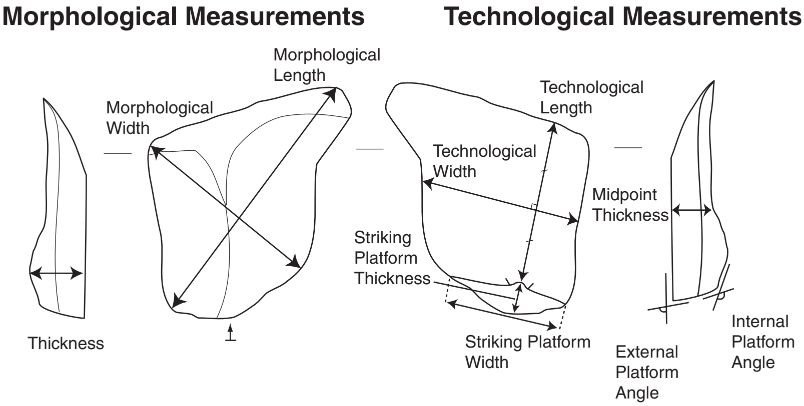


FIGURE A2.5. Flake morphological and technological measurements.

- *Right* – thickest to the right of the median plane
- *Medial* – thickest in the median plane
- *Left* – thickest to the left of the median plane
- *Even* – even thickness medio-laterally

Termination Type notes the trajectory of the ventral surface at the distal end of the flake (Figure A2.4b).

- *Feather* – ventral surface does not curve and intersects with the dorsal surface at an acute angle (<90°).
- *Hinge* – ventral surface curves abruptly >90° toward the dorsal plane.
- *Plunging* – ventral surface curves abruptly >90° toward the ventral plane.
- *Step* – flake ends in a break aligned perpendicularly to the dorsal and ventral surfaces. (Technically, any flake with such a "step" termination is, by definition, an incomplete flake. Lithic analysts usually only designate a complete flake as "step-terminated" if they perceive from the plan-form shape of the artifact that only a relatively small part of the distal end of the tool is missing.)

Débitage – Continuous Variables

Usually, only complete flakes are measured, but some analysts also measure aspects of striking platform morphology on proximal flake fragments (Figure A2.5).

Striking Platform Width – measured between the two most distant points on the striking platform along the plane defined by the intersection of the dorsal and ventral surfaces.

Striking Platform Thickness – measured between the point of impact and the closest point at which striking platform surface and dorsal surface intersect with one another.

External Platform Angle – the angle between the striking platform and the dorsal surface measured at either the point of fracture initiation or at the median of flake width (on flakes lacking a clear point of fracture initiation).

Internal Platform Angle – the angle between the striking platform and the ventral surface measured at either the point of fracture initiation or at the median of flake width (on flakes lacking a clear point of fracture initiation).

For other flake measurements, there are two sets of conventions. "Morphological" measurements focus on the maximum dimensions of the artifact. "Technological" measurements are anchored to specific landmarks on the flake.

Morphological Length – measured between the two most distant points on the flake.

Morphological/Maximum Width – measured perpendicular to the axis of maximum length.

Morphological/Maximum Thickness – measured between the two most distant points on the dorsal and ventral surfaces perpendicular to the plane defined by the dorsal and ventral surfaces.

Technological Length – measured from the point of impact to opposite point on the distal end as measured along a line perpendicular to the width of the striking platform.

Technological/Midpoint Width – measured at the midpoint of the length and perpendicular to the technological long axis.

Technological/Midpoint Thickness – the thickness of the flake measured at the intersection of technological length and width axes.

III. RETOUCHED TOOLS

Measurements of retouched tools vary somewhat from artifact-type to artifact-type (Brézillon 1977), and thus this section focuses on those measurements common to most, if not all, retouched tools.

Retouched Tools – Discrete Variables

All retouched tools are, by definition, incomplete flakes; nevertheless, many of the same discrete variables noted for retouched tools are the same as those for flakes. These include *Striking Platform Morphology*, *Cortex Extent*, *Dorsal Surface Morphology*, *Distal-Proximal Symmetry*, and *Medio-Lateral Symmetry*. These discrete variables are measured in more or less the same way as defined for flakes. Retouched tool *completeness* is typically measured in reference to templates specific to particular artifact-types.

Retouched Tools – Continuous Variables

Most of the continuous variables measured on retouched tools are the morphological variables (length, width, thickness) discussed previously for flakes. Lithic analysts sometimes supplement measurements of whole retouched tools with measurements of retouched edges (discussed in the next section).

IV. MEASURING RETOUCHED EDGES

Retouch – Discrete Variables

Included in this discussion are common discrete measurements of retouch mode, retouched edge shape in plan view, and location of the retouched edge.

Retouch mode is a nominal-scale classification of retouch. Particular named types of retouch recognized by Levantine prehistorians vary among different time periods (see Chapters 2–7).

Edge shape in plan view is a significant variable in most retouched tool typologies. This variable can be classified as follows (Figure A2.4c):

- *Point/Projection*
- *Convex*
- *Straight*
- *Concave*
- *Recurved*
- *Denticulate*

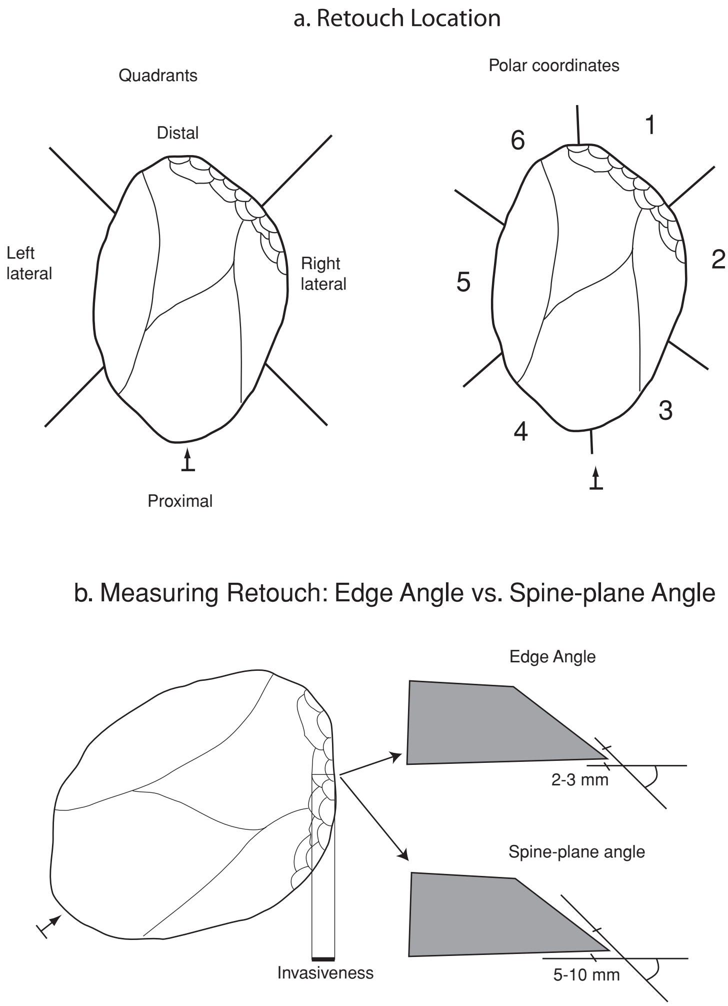


FIGURE A2.6. Measuring retouch: a. location of retouched edge – quadrants versus polar coordinates, b. retouch invasiveness – edge angle versus spine-plane angle.

Location of a retouched edge on a tool can be recorded in a variety of ways, either by reference to quadrants (distal, proximal, right lateral, or left lateral) or to a polar-coordinate grid (Figure A2.6a). The choice of one or the other method depends on the level of precision required by a particular research objective.

Retouch – Continuous Variables

These variables include commonly made continuous measurements of retouch, including invasiveness, edge-angle, and spine-plane angle (Figure A2.6b).

Invasiveness refers to the extent to which retouch propagates across the surface of the tool and from the edge on which it originates. Because the values of this variable can vary at different points on the same edge, analysts usually take an average of several measurements (Clarkson 2002, Eren et al. 2005, Kuhn 1990).

The edge angle is the angle formed by the intersection of the dorsal and ventral sides of a retouched edge measured at a point close to the edge (2–3 mm). As with invasiveness, this measurement is usually a computed average.

The spine-plane angle is essentially the same as the edge angle, but measured at a greater distance from the edge (5–10 mm) – a distance sufficient to remove the effects of use-related wear from altering its values.

V. POUNDED PIECES

Pounded Pieces – Discrete Variables

The principal discrete variables measured on pounded pieces relate to the degree to which their surfaces have been modified by percussion damage. For visual assessments, this can be most easily and effectively estimated by a simple template-based classification of roundness/angularity (Figure A2.4d).

Pounded Pieces – Continuous Variables

The most common measurements made on pounded pieces are ones related to their overall size. These include morphological length, width, and thickness defined in more or less the same way as for cores (see previous discussion on cores).

BIBLIOGRAPHY

Abbès, F. 2003. *Les outillages néolithique en Syrie du Nord: Méthode de débitage et gestion laminaire durant le PPNB*. Oxford, UK: British Archaeological Reports International Series 1150.

Addington, L. 1986. *Lithic Illustration: Drawing Flaked Stone Artifacts for Publication*. Chicago: University of Chicago Press.

Ahmad, G. S., and J. J. Shea. 2009. *Reconstructing Late Pleistocene Human Behavior in the Jordan Valley: The Middle Paleolithic Stone Tool Assemblage from Ar Rasfa*. Oxford, UK: Archaeopress (British Archaeological Reports International Series S-2042).

Aiello, L. C., and J. C. K. Wells. 2002. Energetics and the evolution of the Genus Homo. *Annual Review of Anthropology* 31:323–338.

Akazawa, T. 1975. Preliminary notes of the Middle Paleolithic assemblage from the Shanidar Cave. *Sumer* 31:3–10.

Akazawa, T., and S. Muhesen. Editors. 2002. *Neanderthal Burials: Excavations of the Dederiyeh Cave, Afrin, Syria*. Kyoto, Japan: International Research Center for Japanese Studies.

Akazawa, T., and Y. Sakaguchi. Editors. 1987. *Paleolithic Site of the Douara Cave and Paleogeography of the Palmyra Basin in Syria. Part IV: 1984 Excavations*. Tokyo: University of Tokyo Museum Bulletin No. 29.

Al-Nahar, M. 2010. Tell Abu Suwwan: A Neolithic Site in Jordan: Preliminary Report on the 2005 and 2006 Field Seasons. *Bulletin of the American Schools of Oriental Research* 357:1–18.

Alperson, N., and Y. Garfinkel. 2002. "The Flint Knapping Industry," in *Sha'ar Hagolan Vol 1. Neolithic Art in Context*. Edited by G. Y. and M. M, pp. 146–175. Oxford, UK: Oxbow.

Andrefsky, W. J. 2005. *Lithics: Macroscopic Approaches to Analysis, Second Edition*. New York: Cambridge University Press.

Aprahamian, G. D. 2001. "Le dessin du materiel lithique," in *Beyond Tools: Redefining the PPN Lithic Assemblages of the Levant*. Edited by I. Caneva, C. Lemorini, D. Zampetti, and P. Biagi, pp. 93–106. Berlin: ex oriente.

Aurenche, O., and S. Kozlowski. 1999. *La naissance du néolithique au Proche Orient: ou le paradis perdu*. Paris: Éditions Errance.

Aurenche, O., and S. Kozlowski. 2011. "The spatial distribution of arrowheads and microliths in the Near East (10,200–8,000 cal. BC)," in *The State of the Stone: Terminologies, Continuities and Contexts in Near Eastern Lithics*. Edited by E. Healey, S. Campbell, and O. Maeda, pp. 449–456. Berlin: ex oriente.

Azoury, I. 1986. *Ksar Akil, Lebanon. A Technological and Typological Analysis of the Transitional and Early Upper Paleolithic Levels at Ksar Akil and Abu Halka. Volume 1: Levels XXV–XII*. Oxford: BAR international Series (no. 289).

Bamforth, D. B., and P. Bleed. 1997. "Technology, Flaked Stone Technology, and Risk," in *Rediscovering Darwin: Evolutionary Theory and Archeological Explanation, Archaeological Papers of the American Anthropological Association, No. 7*. Edited by C. M. Barton and G. A. Clark, pp. 109–139. Washington, D.C.: American Anthropological Association.

Banning, E. B. 2007. Time and Tradition in the Transition from Late Neolithic to Chalcolithic: Summary and Conclusions. *Paléorient* 33:137–142.

Bar-Matthews, M., and A. Ayalon. 2003. "Climatic Conditions in the Eastern Mediterranean During the Last Glacial (60–10 ky) and Their Relations to the Upper Palaeolithic in the Levant as inferred from Oxygen and Carbon Isotope Sytematics of Cave Deposits," in *More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East*. Edited by A. N. Goring-Morris and A. Belfer-Cohen, pp. 13–18. Oxford: Oxbow Books.

Bar-Matthews, M., and A. Ayalon. 2004. "Speleothems as Palaeoclimate Indicators, A Case Study from Soreq Cave Located in the Eastern Mediterranean Region, Israel," in *Past Climate Variability through Europe and Africa*. Edited by R. W. Battarbee, F. Gasse, and C. Stickley, pp. 363–391. Dordrecht, Netherlands: Springer.

Bar-Yosef, O. 1970. The Epipaleolithic Cultures of Palestine. PhD Dissertation (unpublished), Hebrew University

Bar-Yosef, O. 1975. "Archaeological occurrences in the Middle Pleistocene of Israel," in *After the Australopithecines: Stratigraphy, Ecology, and Culture Change in the Middle Pleistocene*. Edited by K. W. Butzer and G. L. Isaac, pp. 571–604. Chicago: Aldine.

Bar-Yosef, O. 1980. Prehistory of the Levant. *Annual Review of Anthropology* 9:101–133.

Bar-Yosef, O. 1981. "The Epipaleolithic Complexes in the Southern Levant," in *Préhistoire du Levant*. Edited by J. Cauvin and P. Sanlaville, pp. 389–408. Paris: CNRS.

Bar-Yosef, O. 1989. "Upper Pleistocene Cultural Stratigraphy in Southwest Asia," in *The Emergence of Modern Humans*. Edited by E. Trinkaus, pp. 154–179. Cambridge: Cambridge University Press.

Bar-Yosef, O. 1991. "The Archaeology of the Natufian Layer at Hayonim Cave," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 81–92. Madison, WI: International Monographs in Prehistory.

Bar-Yosef, O. 1994. The Lower Paleolithic of the Near East. *Journal of World Prehistory* 8:211–265.

Bar-Yosef, O. 1995. "Earliest Food Producers – Pre-Pottery Neolithic (8000–5500)," in *Archaeology of Society in the Holy Land*. Edited by T. E. Levy, pp. 190–204. New York: Facts on File.

Bar-Yosef, O. 2000. "The Middle and Early Upper Paleolithic in Southwest Asia and Neighboring Regions," in *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean*. Edited by O. Bar-Yosef and D. Pilbeam, pp. 107–156. Cambridge, MA: Peabody Museum of Archaeology and Ethnology, Bulletin No. 8.

Bar-Yosef, O. 2001. The Origin of Human Social Institutions. *Proceedings of the British Academy* 110:1–38.

Bar-Yosef, O. 2002. The Upper Paleolithic Revolution. *Annual Review of Anthropology* 31:363–393.

Bar-Yosef, O. 2011. Climatic Fluctuations and Early Farming in West and East Asia. *Current Anthropology* 52:S175–S193.

Bar-Yosef, O., and D. Alon. 1988. *Nahal Hemar Cave*. Atiqot XVIII.

Bar-Yosef, O., and A. Belfer-Cohen. 1989. The origins of sedentism and farming communities in the Levant. *Journal of World Prehistory* 3:447–498.

Bar-Yosef, O., and A. Belfer-Cohen. 2004. The Qafzeh Upper Paleolithic Assemblages: 70 Years Later. *Eurasian Prehistory* 2:145–180.

Bar-Yosef, O., and A. Belfer-Cohen. 2010. "The Levantine Upper Palaeolithic and Epipalaeolithic," in *South-Eastern Mediterranean Peoples Between 130,000–10,000 Years Ago*. Edited by E. Garcea, pp. 144–167. Oxford, UK: Oxbow Books.

Bar-Yosef, O., and A. Gopher. Editors. 1997. *An Early Neolithic Village in the Jordan Valley. Part 1: The Archaeology of Netiv Hagdud*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.

Bar-Yosef, O., and N. Goren. 1973. Natufian Remains from Hayonim Cave. *Paléorient* 1:49–68.

Bar-Yosef, O., and N. Goren-Inbar. 1993. *The Lithic Assemblages of 'Ubeidiya. Qedem 34*. Jerusalem: Hebrew University Institute of Archaeology.

Bar-Yosef, O., A. N. Goring-Morris, and A. Gopher. Editors. 2010. *Gilgal: Early Neolithic Occupations in the Lower Jordan Valley: The Excavations of Tamar Noy*. Oakville, CT: Oxbow Books.

Bar-Yosef, O., and S. L. Kuhn. 1999. The big deal about blades: Laminar technologies and human evolution. *American Anthropologist* 101:322–338.

Bar-Yosef, O., and L. Meignen. 1992. "Insights into Levantine Middle Palaeolithic Cultural Variability," in *The Middle Paleolithic: Adaptation, Behavior and Variability*. Edited by H. Dibble and P. Mellars, pp. 163–182. Philadelphia: The University Museum, University of Pennsylvania Press.

Bar-Yosef, O., and L. Meignen. *Editors*. 2008. *Kebara Cave, Mt. Carmel, Israel: The Middle and Upper Paleolithic Archaeology Part I*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology, Harvard University (American School of Prehistoric Research Bulletin 49).

Bar-Yosef, O., and J. L. Phillips. Editors. 1977. *Prehistoric Investigations in the Gebel Maghara, Northern Sinai. Qedem: Monographs of the Hebrew University of Jerusalem*. Jerusalem: Hebrew University Institute of Archaeology.

Bar-Yosef, O., and F. Valla. 1991. "The Natufian Culture – an introduction," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 1–10. Madison, WI: International Monographs in Prehistory.

Bar-Yosef, O., and B. Vandermeersch. 1972. "The stratigraphical and cultural problems of the passage from Middle to Upper Paleolithic in Palestinian caves," in *The Origin of Homo sapiens/Origine de l'homme modern*. Edited by F. Bordes, pp. 221–225. Paris: UNESCO.

Bar-Yosef, O., and J. C. Vogel. 1987. "Relative and Absolute Chronology of the Epipaleolithic in the Southern Levant," in *Chronologie du Proche-Orient, 16.000–4.000 BP*. Edited by O. Aurenche and F. Hours, pp. 219–245. Oxford: British Archaeological Reports International Series.

Barkai, R. 2005. *Flint and Stone Axes as Cultural Markers. Socio-Economic Changes as Reflected in Holocene Flint Tool Industries of the Southern Levant*. Berlin: ex oriente.

Barkai, R. 2011. "The evolution of Neolithic and Chalcolithic woodworking tools and the intensification of human production: axes, adzes, and chisels from the Southern Levant," in *Stone Axe Studies III*. Edited by V. Davis and M. Edmonds, pp. 39–54. Oxford: Oxbow Books.

Barkai, R., A. Gopher, S. E. Lauritzen, and A. Frumkin. 2003. Uranium series dates from Qesem Cave, Israel, and the end of the Lower Palaeolithic. *Nature* 423:977–979.

Barkai, R., A. Gopher, and R. Shimelmitz. 2006. Middle Pleistocene blade production in the Levant: An Amudian assemblage from Qesem Cave, Israel. *Eurasian Prehistory* 3:39–74.

Barkai, R., C. Lemorini, R. Shimelmitz, Z. Lev, M. C. Stiner, and A. Gopher. 2009. A blade for all seasons? Making and using Amudian blades at Qesem Cave, Israel. *Human Evolution* 24:57–75.

Barnes, A. S. 1939. The difference between natural and human flaking in prehistoric flint implements. *American Anthropologist* 41:99–112.

Barton, C. M., D. I. Olszewski, and N. R. Coinman. 1996. Beyond the Graver: Reconsidering Burin Function. *Journal of Field Archaeology* 23:111–125.

Bartram, L. E., Jr. 1997. "A comparison of Kua (Botswana) and Hadza (Tanzania) Bow and Arrow Hunting," in *Projectile Technology*. Edited by H. Knecht, pp. 321–344. New York: Plenum.

Baruch, U., and O. Bar-Yosef. 1986. Upper Palaeolithic Assemblages from Wadi Sudr, Western Sinai. *Paléorient* 12:69–84.

Barzilai, O. 2009. Social complexity in the southern levantine PPNB as reflected through lithic studies: the bidirectional blade industries. unpublished PhD Dissertation, Hebrew University.

Baumler, M. F., and J. D. Speth. 1993. "A Middle Paleolithic Assemblage from Kunji Cave, Iran," in *The Paleolithic Prehistory of the Zagros-Taurus*. Edited by D. Olzewski and H. L. Dibble, pp. 1–73. Philadelphia, PA: University of Pennsylvania Museum (Monograph No. 83).

Beauchamp, E. K., and B. A. Purdy. 1986. Decrease in Fracture Toughness in Chert by Heat Treatment. *Journal of Materials Science* 21:1963–1966.

Belfer-Cohen, A., and O. Bar-Yosef. 1981. The Aurignacian at Hayonim Cave. *Paléorient* 7:19–42.

Belfer-Cohen, A., and O. Bar-Yosef. 1999. "The Levantine Aurignacian: 60 years of research," in *Dorothy Garrod and the Progress of the Palaeolithic: Studies in the Prehistoric Archaeology of the Near East and Europe*. Edited by W. Davies and R. Charles, pp. 118–134. Oxford, UK: Oxbow Books.

Belfer-Cohen, A., A. Davidzon, A. N. Goring-Morris, D. E. Lieberman, and M. Spiers. 2004. Nahal Ein Gev I: A Late Upper Palaeolithic Site by the Sea of Galilee, Israel. *Paléorient* 30:24–45.

Belfer-Cohen, A., and A. N. Goring-Morris. 1986. Har Horesha I: An Upper Palaeolithic Site in the Central Negev Highlands. *Mitekufat Haeven – Journal of the Israel Prehistoric Society* 19:43–57.

Belfer-Cohen, A., and A. N. Goring-Morris. 2003. "Current Issues in Levantine Upper Palaeolithic Research," in *More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East*. Edited by A. N. Goring-Morris and A. Belfer-Cohen, pp. 1–12. Oxford: Oxbow Books.

Belfer-Cohen, A., and A. N. Goring-Morris. 2002. "Why Microliths? Microlithization in the Levant," in *Thinking Small: Global Perspectives* *on Microlithization*. Edited by R. G. Elston and S. L. Kuhn, pp. 57–68. Washington, D.C.: American Anthropological Association (Archaeological Paper No. 12).

Belfer-Cohen, A., and A. N. Goring-Morris. 2007. "From the Beginning: Levantine Upper Palaeolithic Cultural Change and Chronology," in *Rethinking the Human Revolution*. Edited by P. Mellars, K. Boyle, O. Bar-Yosef, and C. Stringer, pp. 199–206. Cambridge, UK: McDonald Institute for Archaeological Research Monographs.

Belfer-Cohen, A., and A. N. Goring-Morris. 2011. Becoming Farmers: The Inside Story. *Current Anthropology* 52:S209-S220.

Belfer-Cohen, A., and L. Grosman. 1997. The lithic assemblage of Salibiya I. *Journal of the Israel Prehistoric Society* 27:19–41.

Belfer-Cohen, A., and L. Grosman. 2007. "Tools or Cores? And why does it matter: Carinated artifacts in Levantine Late Upper Paleolithic Assemblages," in *Tools versus Cores: Alternative Approaches to Stone Tool Analysis*. Edited by S. McPherron, pp. 143–163. Newcastle: Cambridge Scholars Publishing.

Bender, B. 1978. From Gatherer-Hunter to Farmer: A Social Perspective. *World Archaeology* 10:204–222.

Bergman, C. A. 1981. "Point Types in the Upper Palaeolithic Sequence at Ksar Akil, Lebanon," in *Préhistoire du Levant*. Edited by J. Cauvin and P. Sanlaville, pp. 319–330. Paris: C.N.R.S.

Bergman, C. A. 1987. *Ksar Akil, Lebanon. A Technological and Typological Analysis of the Later Paleolithic Levels at Ksar Akil. Volume II: Levels XIII–VI.* Oxford: British Archaeological Reports International Series (no. 329).

Bergman, C. A. 1988. "Upper Palaeolithic Point Types at Ksar Akil, Lebanon," in *Ksar Akil, Lebanon: A Technological Study of the Earlier Upper Palaeolithic Levels of Ksar Akil Volume III: Levels XXV-XIV*, pp. 311–328. Oxford, UK: British Archaeological Reports International Series 426.

Bergman, CA., and M. H. Newcomer. 1983. Flint Arrowhead Breakage: Examples from Ksar Akil, Lebanon. *Journal of Field Archaeology* 10:238–243.

Binford, L. R. 1968. "Post-Pleistocene Adaptations," in *New Perspectives in Archaeology*. Edited by L. Binford and S. Binford, pp. 313–341. Chicago: Aldine.

Binford, L. R. 1982. The Archaeology of Place. *Journal of Anthropological Archaeology* 1:5–31.

Binford, L. R. 1989. "Isolating the Transition to Cultural Adaptations: An Organizational Approach," in *The Emergence of Modern Humans: Biocultural Adaptations in the Later Pleistocene*. Edited by E. Trinkaus, pp. 18–41. New York.: Cambridge University Press.

Binford, L. R., and S. R. Binford. 1969. Stone tools and human behavior. *Scientific American* 220:70–84.

Binford, S. R. 1966. Me'arat Shovakh (Mugharet es-Shubbabiq). *Israel Exploration Journal* 16:18–32, 96–113.

Bisson, M. S. 2000. Nineteenth Century Tools for Twenty-First Century Archaeology? Why the Middle Paleolithic Typology of François Bordes Must Be Replaced. *Journal of Archaeological Method and Theory* 7:1–48.

Blondel, J., and J. Aronson. 1999. *Biology and Wildlife of the Mediterranean Region*. New York: Oxford University Press.

Bocquet-Appel, J.-P. 2011. The Agricultural Demographic Transition During and After the Agriculture Inventions. *Current Anthropology* 52:S510–S510.

Boëda, E. 1988. "Le Concept Levallois et évaluation de son champ d'application," in *L'homme de Neandertal. Vol. 4 La Technique*, Edited by M. Otte, pp. 13–26. Liège: ERAUL.

Boëda, E. 1991. Approche de la variabilité des systèmes de production lithique des industries du paléolithique inférieur et moyen: chronique d'une varabilité attendue. *Techniques et Culture* 17/18:37–79.

Boëda, E. 1995. "Levallois: A Volumetric Construction, Methods, a Technique," in *The Definition and Interpretation of Levallois Technology*. Edited by H. L. Dibble and O. Bar-Yosef, pp. 41–68. Madison, WI: Prehistory Press Monographs in World Archaeology No. 23.

Boëda, E., and S. Bonilauri. 2006. The Intermediate Paleolithic: The First Bladelet Production, 40,000 Years Ago. *Anthropologie* LXIV:75–92.

Boëda, E., J. Connan, D. Dessort, S. Muhesen, R. Mercier, H. Valladas, and N. Tisnérat. 1996. Bitumen as a hafting material on Middle Palaeolithic artefacts. *Nature* 380:336–338.

Boëda, E., J.-M. Geneste, and L. Meignen. 1990. Identification de chaines opératoires lithiques du Paléolithique ancien et moyen. *Paléo* 2:43–80.

Boëda, E., C. Griggo, and S. Soriano. 2001. Différents modes d'occupation du site d'Umm el Tlel au cours du Paléolithique moyen (El Kowm, Syrie central). *Paléorient* 27:13–28.

Boese, J. 1995. *Ausgrabungen in Tell Sheikh Hassan. Vorläufige Berichte über die Ausgrabungskampagnen 1984–1990 und 1992–1994*. Vol. I. Saarbrücken: Druckerei und Verlag.

Bordaz, J. 1970. *Tools of the Old and New Stone age*. Garden City, NY: Natural History Press.

Bordaz, J., and L. A. Bordaz. 1973. "Stone knapping in modern Turkey Film," University of Pennsylvania Museum of Archaeology and Anthropology (Penn Museum).

Bordes, F. 1961. *Typologie du Paléolithique ancien et moyen*. Bordeaux: Delmas.

Bordes, F. 1969. Reflections on technology and techniques in the Paleolithic. *Arctic Anthropology* 6:1–29.

Bordes, F. 1977. Que sont le Pre-Aurignacien et le Yabroudien? *Eretz-Israel (Stekelis Memorial Volume)* 13:49–55.

Bordes, F., and M. Bourgon. 1951. Le Complex Moustériene: Moustériens, Levalloisien et Tayacien. *L'Anthropologie* 55:1–23.

Bosinski, G. 1967. *Die Mittelpaläolithischen Funde im westlichen Mitteleuropa. Fundamenta: Monographen zur Urgeschichte*. Köln.

Bourdieu, P. 1977. *Outline of a Theory of Practice*. Cambridge, UK: Cambridge University Press.

Bourguignon, L. 1998. "Les industries du Paléolithique intermédiare d'Umm el Tlell: nouveaux élements pour le passage entre Paléolithique moyen et supérieur dans le Bassin d'El Khowm," in *Préhistoire d'Anatolie: Genèse de deux mondes/Anatolian Prehistory: At the Crossroad of Two Worlds*. Edited by M. Otte, pp. 709–730. Liège, Belgium: Etudes et Recherches Archéologiques de L'Université de Liège.

Boutié, P., and S. Rosen. 1989. "Des gisements Moustériens dans le Neguev central: resultats preliminaires de prospections," in *Investigations in South Levantine Prehistory/Préhistoire du Sud-Levant*. Edited by O. Bar-Yosef and B. Vandermeersch, pp. 169–185. Oxford: British Archaeological Reports International Series 497.

Braidwood, R. J. 1960. The Agricultural Revolution. *Scientific American* 203:130–148.

Braidwood, R.J. 1961. "The general appearance of obsidian in Southwestern Asia and the microlithic side-blow blade-flake in obsidian," in *Bericht über den V. Internationalen Kongress für Vor und Frühgeschichte, Hamburg, August 1958* Edited by G. Bersu, pp. 142–147. Berlin: Mann.

Braidwood, R. J., H. Cambel, B. Lawrence, C. L. Redman, and R. B. Stewart. 1974. Beginnings of Village-Farming Communities in Southeastern Turkey—1972. *Proceedings of the National Academy of Sciences* 71:568–572.

Braun, D. R., J. C. Tactikos, J. V. Ferraro, and J. W. K. Harris. 2005. Flake recovery rates and inferences of Oldowan hominin behavior: a response to Kimura 1999, 2002. *Journal of Human Evolution* 48:525–531.

Brézillon, M. 1977. *La dénomination des objets de pierre taillée (Second Edition). Gallia Préhistoire Fourth Supplement*. Paris: CNRS.

Brown, K. S., C. W. Marean, A. I. R. Herries, Z. Jacobs, C. Tribolo, D. Braun, D. L. Roberts, M. C. Meyer, and J. Bernatchez. 2009. Fire As an Engineering Tool of Early Modern Humans. *Science* 325:859–862.

Burroughs, W. J. 2005. *Climate Change in Prehistory: The End of the Reign of Chaos*. Cambridge, UK: Cambridge University Press.

Byrd, B. 1988. Late Pleistocene Settlement Diversity in the Azraq Basin. *Paléorient* 14:257–264.

Byrd, B. 1991. "Beidha: An Early Natufian Encampment in Southern Jordan," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 245–264. Madison, WI: International Monographs in Prehistory.

Byrd, B., and S. College. 1991. "Early Natufian occupation along the edge of the southern Jordanian steppe," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 265–276. Madison, WI: International Monographs in Prehistory.

Byrd, B. F., and A. N. Garrard 1992. New Dimensions to the Epipalaeolithic of the Wadi el-Jilat in Central Jordan. *Paléorient* 18:47–62.

Cahen, D., L. H. Keeley, and F. L. Van Noten. 1979. Stone Tools, Toolkits, and Human Behavior in Prehistory. *Current Anthropology* 20:661–683.

Callander, J. 2004. Dorothy Garrod's excavations in the Late Mousterian of Shukbah Cave, Palestine reconsidered. *Proceedings of the Prehistoric Society* 70:207–231.

Cann, J. R., J. E. Dixon, and C. Renfrew. 1969. "Obsidian analysis and the obsidian trade," in *Science in archaeology. A survey of progress and research*. Edited by D. Brothwell and E. Higgs, pp. 578–591. London: Thames and Hudson.

Cauvin, J. 1968. *Fouilles de Byblos IV: les outillages néolithiques de Byblos et du littoral libanais*. Paris Libraire d'Amérique et d'Orient, Adrien Maisonneuve.

Cauvin, J. 2000. *The Birth of the Gods and the Origin of Agriculture*. Cambridge: Cambridge University Press.

Cauvin, M.-C. 1974a. Flèches à encoches de Syrie: essai de classification et d'interprétation culturelle. *Paléorient* 2:311–322.

Cauvin, M.-C. 1974b. Outillage lithique et chronologie à Tell Aswad (Damascène, Syrie). *Paléorient* 2:429–436.

Cauvin, M.-C. 1975. Outillage lithique et chronologie de Tell Ghoraifé C (Damascène – Syrie). *Paléorient* 3:295–304.

Cauvin, M.-C. 1983. Les faucille préhistoriques du Proche-Orient données morphologiques et fonctionelles. *Paléorient* 9:63–79.

Cauvin, M.-C. 1991. "Du Natoufien au Levant nord? Jayroud et Mureybit (Syrie)," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 295–314. Madison, WI: International Monographs in Prehistory.

Cauvin, M.-C., and F. Abbès. 2008. "Analyse du mobilier retouché," in *Le site néolithique de Tel Mureybit (Syrie du Nord): En hommage à Jacques Cauvin*, vol. 1. Edited by J. J. Ibàñez, pp. 281–362. Oxford: British Archaeological Reports International Series 1843 (2 volumes).

Cauvin, M. C., and E. Coqueugniot. 1989. *Téchniques d'echantillonage et analse spatiale. Le campement épipaléolithique de Nadaouiyeh-2 (El Kowm, Syrie).*

Vol. 522. Oxford, UK: British Archaeological Reports International Series.

Chandler, L. 1981. "La fin de l'Acheuléen et l'avèntment du Paléolithque Moyen en Syrie," in *Préhistoire du Levant*. Edited by J. Cauvin and P. Sanlaville, pp. 225–238. Paris: CNRS.

Chazan, M. 1997. Redefining Levallois. *Journal of Human Evolution* 33:719–735.

Chazan, M., and L. K. Horwitz. Editors. 2007. *Holon: A Lower Paleolithic Site in Israel*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.

Childe, V. G. 1925. *The Dawn of European Civilization*. London: Kegan Paul.

Childe, V. G. 1936. *Man Makes Himself*. London: C. A. Watts.

Churchill, S. E. 1993. "Weapon Technology, Prey Size Selection, and Hunting Methods in Modern Hunter-Gatherers: Implications for Hunting in the Palaeolithic and Mesolithic," in *Hunting and Animal Exploitation in the Later Paleolithic and Mesolithic of Eurasia, American Anthropological Association Archaeological Paper No. 4*. Edited by G. L. Peterkin, H. Bricker, and P. A. Mellars, pp. 11–24. Washington, D.C.: American Anthropological Association.

Clark, G. A., and J. Riel-Salvatore. 2006. "Observations on Systematics in Paleolithic Archaeology," in *Transitions before the Transition*. Edited by E. Hovers and S. L. Kuhn, pp. 29–57. New York: Plenum/Kluwer.

Clark, J. D. 1955. "The Stone Ball: Its Associations and Use by Prehistoric Man in Africa," in *Congrès Panafricain de Préhistoire: Actes de la IIe Session (Alger 1952)*. Edited by L. Balout, pp. 403–417. Paris: Arts et Métiers Graphiques.

Clark, J. D. 1967. The Middle Acheulian Occupation site at Latamne, northern Syria. *Quaternaria* 9:1–68.

Clarke, D. L. 1976. "Mesolithic Europe: the Economic Basis," in *Problems in Economic and Social Archaeology*. Edited by G. Sieveking, J. H. Longworth, and K. E. Wilson, pp. 444–481. London: Duckworth.

Clarke, D. L. 1978. *Analytical Archaeology (Second Edition)*. New York: Columbia University Press.

Clarkson, C. 2002. An index of Invasiveness of the Measurement of Unifacial and Bifacial Retouch: A Theoretical, Experimental, and Archaeological Verification. *Journal of Archaeological Science* 29:65–75.

Clarkson, C., L. Vinicius, and M. M. Lahr. 2006. Quantifying flake scar patterning on cores using 3D recording techniques. *Journal of Archaeological Science* 33:132–142.

Coceuegniot, E. 1991. "Outillage de pierre taillée au Bronze Récent: Ras Shamra 1978–1988," in *Arts et Industries de la Pierre: Ras Shamra-Ougarit VI*. Edited by M. Yon, pp. 127–204. Paris: Éditions Recherch sur le Civilisations.

Cohen, M. N. 1977. *The Food Crisis in Prehistory: Overpopulation and the Origins of Agriculture*. New Haven, CT: Yale University Press.

Coinman, N. R. Editor. 1998. *The Archaeology of the Wadi al-Hasa, West-Central Jordan, Volume 1: Surveys, Settlement Patterns, and Paleoenvironments*. Tempe, AZ: Arizona State University Anthropological Research Papers, No. 50.

Coinman, N. R. 2000a. "WHS 618 – Ain el Buhira: An Upper Paleolithic Site in the Wadi Hasa, West-Central Jordan," in *The Archaeology of the Wadi al-Hasa, West-Central Jordan, Volume 2: Excavations at Middle, Upper, and Epipaleolithic Sites*. Edited by N. Coinman, pp. 161–182. Tempe, AZ: Arizona State University Anthropological Research Papers, No. 52.

Coinman, N. R. 2000b. "The Upper Paleolithic in the Wadi al-Hasa," in *The Archaeology of the Wadi al-Hasa, West-Central Jordan, Volume 2: Excavations at Middle, Upper, and Epipaleolithic Sites*. Edited by N. R. Coinman, pp. 143–160. Tempe, AZ: Arizona State University Anthropological Research Papers, No. 52.

Coinman, N. R. 2002. New evidence of Ksar Akil Scrapers in the Levantine Upper Paleolithic. *Paléorient* 28:87–104.

Coinman, N. R. 2003. "The Upper Palaeolithic of Jordan: New Data from Wadi al-Hasa," in *More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East*. Edited by A. N. Goring-Morris and A. Belfer-Cohen, pp. 151–170. Oxford: Oxbow Books.

Coinman, N. R., and J. R. Fox. 2000. "Tor Sadaf (WHNBS 8) The Transiton to the Upper Paleolithic," in *The Archaeology of the Wadi al-Hasa, West-Central Jordan, Volume 2: Excavations at Middle, Upper, and Epipaleolithic Sites*. Edited by N. Coinman, pp. 123–1142. Tempe, AZ: Arizona State University Anthropological Research Papers, No. 52.

Coinman, N. R., and D. O. Henry. 1995. "The Upper Paleolithic Sites," in *Prehistoric Cultural Ecology and Evolution: Insights from Southern Jordan*. Edited by D. O. Henry, pp. 133–213. New York: Plenum.

Conard, N. J., M. Soressi, J. E. Parkington, S. Wurz, and R. Yates. 2004. A Unified Lithic Taxonomy Based on Patterns of Core Reduction. *South African Archaeological Bulletin* 59:13–17.

Copeland, L. 1970. The early Upper Paleolithic flint material from Levels VII-V, Antelias Cave, Lebanon. *Berytus* 19.

Copeland, L. 1975. "The Middle and Upper Palaeolithic of Lebanon and Syria in the light of recent research," in *Problems in Prehistory: North Africa and the Levant*. Edited by F. Wendorf and A. E. Marks, pp. 317–350. Dallas: SMU Press.

Copeland, L. 1981. Levallois or Non-Levallois? Reflections on Some Technical Features of Hummal, Level IA (El-Koum, Syria). *Union Internacional de Ciencias Prehistoricas y Protohistoricas*:1–14.

Copeland, L. 1982. "The Ksar Akil Scraper: A Late Upper Paleolithic Tool-Type of the Levant," in *Archéologie au Levant, Recueil R. Saidah*, pp. 57–67. Lyon: Maison de l'Orient.

Copeland, L. 1983a. "The Levalloiso-Mousterian of Bezez Cave Level B.," in *Adlun in the Stone Age*, vol. 2. Edited by D. A. Roe, pp. 261–324. Oxford, UK: British Archaeological Reports International Series 159 (ii).

Copeland, L. 1983b. "The Palaeolithic industries at Adlun," in *Adlun in the Stone Age, BAR International Series*. Edited by D. A. Roe, pp. 89–247. Oxford, UK: British Archaeological Reports.

Copeland, L. 1989a. "Analysis of the paleolithic artifacts from the sounding of A. Garrard at C-Spring, 1985 Season," in *The Hammer on the Rock: Studies in the Early Palaeolithic of Azraq, Jordan (part 2)*. Edited by L. Copeland and F. Hours, pp. 329–390. Oxford: British Archaeological Reports International Series 540 (ii).

Copeland, L. 1989b. "The artifacts from the sounding of D. Kirkbride at Lion Spring, Azraq in 1956," in *The Hammer on the Rock: Studies in the Early Palaeolithic of Azraq, Jordan (part 1)*. Edited by L. Copeland and F. Hours, pp. 171–212. Oxford: British Archaeological Reports International Series 540 (ii).

Copeland, L. 1991a. The Late Acheulean knapping floor at C-Spring, Azraq Basin, Jordan. *Levant* 23:1–6.

Copeland, L. 1991b. "Natufian Sites in Lebanon," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 27–42. Madison, WI: International Monographs in Prehistory.

Copeland, L. 1998. "The Middle Palaeolithic Flint Industry of Ras el-Kelb," in *The Mousterian Site of Ras el-Kelb, Lebanon*. Edited by L. Copeland and N. Moloney, pp. 73–175. Oxford: British Archaeological Reports, BAR International Series, No. 706.

Copeland, L. 2000. "Yabrudian and related industries: the state of research in 1996," in *Toward Modern Humans: Yabrudian and Micoquian, 400–50 kyears ago*. Edited by A. Ronen and M. Weinstein-Evron, pp. 97–118. Oxford: British Archaeological Reports International Series S850.

Copeland, L. 2003. The Tayacian of the Cordon Littoral, Ras Beirut (Lebanon) and its relations with other Tayacian sites in the Levant. *Paléorient* 29:87–108.

Copeland, L., and F. Hours. 1971. The late Upper Palaeolithic material from Anteilas Cave, Levanon, levels VI-I. *Berytus* 20:57–138.

Copeland, L., and F. Hours. Editors. 1989. *The Hammer on the Rock: Studies in the Early Palaeolithic of Azraq, Jordan*. Oxford: British Archaeological Reports International Series 540.

Copeland, L. and N. Moloney. Editors. 1998. *The Mousterian Site of Ras el-Kelb, Lebanon*. Oxford: British Archaeological Reports International Series 706.

Coqueugniot, E. 2000. "Dja'de (Syrie), un village à la veille de la domestication (seconde moitié du Ixe millenaire av. J.-C.)," in *Premiers Paysans du Monde. Naissance des agricultures*. Edited by J. Guilaine, pp. 61–80. Paris: Errance.

Coskunsu, G. 2007. Obsidian Assemblage of Mezraa Teleilat: Evidence of Cultural and Chronological Continuation from Late Pre-Pottery Neolithic to Pottery Neolithic. *Neo-Lithics* 2007:36–43.

Cotterell, B., and J. Kamminga. 1987. The Formation of Flakes. *American Antiquity* 52:675–708.

Cotterell, B., and J. Kamminga. 1990. *Mechanics of Pre-Industrial Technology*. New York: Cambridge University Press.

Crabtree, D. E. 1972. *An Introduction to Flintworking*. Pocatello, Idaho: Idaho State Museum, Occasional Paper No. 28.

Crabtree, D. E., and E. L. Davis. 1968. Experimental Manufacture of Wooden Implements with Tools of Flaked Stone. *Science* 159:426–428.

Crew, H. L. 1976. "The Mousterian Site of Rosh Ein Mor," in *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. 1*. Edited by A. E. Marks, pp. 75–112. Dallas, TX: Southern Methodist University Press.

Crowfoot-Payne, J. 1983. "The flint industries of Jericho," in *Excavations at Jericho*, vol. 5. Edited by K. M. Kenyon and T. A. Holland, pp. 622–759. London: The British School of Archaeology in Jerusalem.

Dag, D. 2008a. "The Flint Knapping Technology," in *Neolithic Ashkelon (Qedem 47)*. Edited by Y. Garfinkel and D. Dag, pp. 93–116. Jerusalem: Institute of Archaeology, Hebrew University.

Dag, D. 2008b. "The Flint Tools," in *Neolithic Ashkelon (Qedem 47)*. Edited by Y. Garfinkel and D. Dag, pp. 117–172. Jerusalem: Institute of Archaeology, Hebrew University.

Davidson, I., and W. Noble. 1993. "Tools and Language in Human Evolution," in *Tools, Language and Cognition in Human Evolution*. Edited by K. R. Gibson and T. Ingold, pp. 363–388. Cambridge, UK: Cambridge University Press.

De Contenson, H. 1989. L'Aswadien, un nouveau faciès du néolithique syrien. *Paléorient* 15:259–262.

De Contenson, H. 2000. *Ramad: Site néolithique en Damascène (Syrie) au VIIIe et VIIe millénaires avant l'ère chrétienne. Bibliothèque Archéologique et Historique 157*. Beirut: Institut Français d'Archéologie du Proche Orient.

de Sonneville-Bordes, D., and J. Perrot. 1954. Lexique Typologique du Paléolithique supérior. *Bullétin de la Société Préhistorique Française* 51:327–333.

de Sonneville-Bordes, D., and J. Perrot. 1955. Lexique Typologique du Paléolithique supérior. *Bullétin de la Société Préhistorique Française* 52:327–335.

de Sonneville-Bordes, D., and J. Perrot. 1956. Lexique Typologique du Paléolithique supérior. *Bullétin de la Société Préhistorique Française* 53:408–421, 547–559.

Deacon, T. W. 1997. *The Symbolic Species: The Co-Evolution of the Brain and Language*. New York: W. W. Norton & Co.

Debénath, A., and H. L. Dibble. 1994. *Handbook of Paleolithic Typology, Vol. 1: Lower and Middle Paleolithic of Europe*. Philadelphia: University of Pennsylvania Press.

Dennell, R. 1983. *European Economic Prehistory*. New York: Academic Press.

Dennell, R. 2009. *The Palaeolithic Settlement of Asia*. Cambridge University Press: Cambridge, UK.

Diamond, J. 1987. The Worst Mistake in the History of the Human Race. *Discover* 8:64–66.

Dibble, H. L. 1984. The Mousterian Industry from Bisitun Cave (Iran). *Paléorient* 10:23–34.

Dibble, H. L. 1987. The interpretation of Middle Paleolithic scraper morphology. *American Antiquity* 52:109–117.

Dibble, H. L. 1995. Middle Paleolithic Scraper Reduction: Background, Clarification, and Review of the Evidence to Date. *Journal of Archaeological Method and Theory* 2:299–368.

Dibble, H. L., and S. J. Holdaway. 1993. "The Middle Paleolithic Industries of Warwasi," in *The Paleolithic Prehistory of the Zagros-Taurus*. Edited by D. Olzewski and H. L. Dibble, pp. 75–99. Philadelphia, PA: University of Pennsylvania Museum (Monograph No. 83).

Dibble, H. L., and Z. Rezek. 2009. Introducing a new experimental design for controlled studies of flake formation: results for exterior platform angle, platform depth, angle of blow, velocity, and force. *Journal of Archaeological Science* 36:1945–1954.

Dickson, F. P. 1980. Making Ground Stone Tools. *Archaeology in Oceania* 15:162–167.

Dickson, F. P. 1982. *Australian Stone Hatchets: A Study in Design and Dynamics*. New York: Academic Press.

Dorrell, P. G. 1983. "Appendix A: Stone Vessels, Tools, and Objects," in *Excavations at Jericho*, vol. 5. Edited by K. M. Kenyon and T. A. Holland, pp. 487–575. London: The British School of Archaeology in Jerusalem.

Düring, B. 2011. *The Prehistory of Asia Minor: From Complex Hunter-Gatherers to Early Urban Societies*. New York: Cambridge University Press.

Echegaray, G. J. 1964. *Excavacioines en la Terraza de "El Khiam" (Jordania) 1*. Madrid: Bibliotheca Praehistorica Hispana V.

Echegaray, G. J., and L. G. Freeman. 1989. A re-evaluation of El Khiam (Desert of Judea). *Aula Orientalis* 7:37–66.

Edwards, P. C. 1991. "Wadi Hammeh 27: an early Natufian site at Pella, Jordan," in *Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 123–148. Ann Arbor, Michigan: International Monographs in Prehistory

Edwards, P. C., S. Bourke, S. Colledge, J. Head, and P. Macumber. 1988. "Late Pleistocene Prehistory in the Wadi al-Hammeh, Jordan," in *The Prehistory of Jordan: The State of Research in 1986*. Edited by A. Garrard and H. G. Gebel, pp. 525–565. Oxford: British Archaeological Reports International Series 396 (ii).

Edwards, P. C., J. C. Meadows, G. Sayej, and M. Westaway. 2004. From the PPNA to the PPNB: New views from the southern Levant afer excavations at Zahrat adhDhra' 2 in Jordan. *Paléorient* 30:21–60.

Eitam, D. 2009. Late Epipalaeolithic Rock-Cut Installations and Groundstone Tools in the Southern Levant. Methodology and Classification System. *Paléorient* 35:77–104.

Ellis, C. J. 1997. "Factors influencing the use of stone projectile tips: An ethnographic perspective," in *Projectile Technology*. Edited by H. Knecht, pp. 37–78. New York: Plenum.

Ellis, R. S., and M. M. Voigt. 1981. Excavations at Gritille, Turkey: 1981. *Paléorient* 7:87–100.

Elston, R. G., and S. L. Kuhn. *Editors*. 2002. *Thinking Small: Global Perspectives on Microlithization*. Washington, D.C.: American Anthropological Association (Archaeological Paper No. 12).

Enoch-Shiloh, D., and O. Bar-Yosef. 1997. "Salibia IX," in *An Early Neolithic Village in the Jordan Valley, Part I: The Archaeology of Netiv Hagdud*. Edited by O. Bar-Yosef and A. Gopher, pp. 13–39. Cambridge, MA: Peabody Museum of Archaeology and Ethnology, Harvard University.

Eren, M. I., M. Dominguez-Rodrigo, S. L. Kuhn, D. S. Adler, I. Le, and O. Bar-Yosef. 2005. Defining and measuring reduction in unifacial stone tools. *Journal of Archaeological Science* 32:1190–1201.

Eren, M. I., A. Greenspan, and C. G. Sampson. 2008. Are Upper Paleolithic blade cores more productive than Middle Paleolithic discoidal cores? A replication experiment. *Journal of Human Evolution* 55:952–961.

Farrand, W. 1994. "Confrontation of Geological Stratigraphy and Radiometric Dates from Upper Pleistocene Sites in the Levant," in *Late Quaternary Chronology and Paleoclimates of the Eastern Mediterranean*. Edited by O. Bar-Yosef and R. S. Kra, pp. 33–54. Tucson: University of Arizona Department of Geosciences.

Ferring, C. R. 1976. "Sde Divshon: An Upper Paleolithic Site on the Divshon Plain," in *Prehistory and Paleoenvironments in the Central Negev,* *Israel, Vol. 1*. Edited by A. E. Marks, pp. 141–198. Dallas: Southern Methodist University Press.

Ferring, C. R. 1977. "The Late Upper Paleolithic Site of Ein Aqev East," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 81–118. Dallas: Southern Methodist University Press.

Finlayson, C. 2009. *The Humans Who Went Extinct: Why Neanderthals Died Out and We Survived*. Oxford, UK: Oxford University Press.

Flannery, K. V. 1969. "Origins and Ecological Effects of Early Domestication in Iran and the Near East," in *The Domestication of Plants and Animals*. Edited by P. J. Ucko and G. W. Dimbleby, pp. 73–100. Chicago: Aldine.

Flannery, K. V. 1973. The origins of agriculture. *Annual Review of Anthropology* 2:271–310.

Fleisch, H. 1970. Les habitats du paléolithique moyen à Naamé (Liban). *Bulletin de la Musée de Beyrouth* 23:25–93.

Fleisch, H., and P. Sanlaville. 1974. La plage de +52m et son Acheulén à Ras Beyrouth et à l'ouadi Aabet, Liban. *Paléorient* 2:45–85.

Frison, G. C. 1969. A Functional Analysis of Certain Chipped Stone Tools. *American Antiquity* 33:149–155.

Frumkin, A., O. Bar-Yosef, and H. P. Schwarcz. 2011. Possible paleohydrologic and paleoclimatic effects on hominin migration and occupation of the Levantine Middle Paleolithic. *Journal of Human Evolution* 60:437–451.

Fullagar, R. L. K. 1991. The Role of Silica in Polish Formation. *Journal of Archaeological Science* 18:1–24.

Galili, E., M. Weinstein-Evron, M. Hershkovitz, A. Gopher, M. E. Kislev, O. Lernau, L. Kolska-Horwitz, and H. Lernau. 1993. Atlit-Yam: a prehistoric site on the sea floor off the Israeli coast. *Journal of Field Archaeology* 20:133–157.

Gamble, C. 2007. *Origins and Revolutions: Human Identity in Earliest Prehistory*. New York, NY: Cambridge University Press.

Garcea, E. A. A. 2010. "The Lower and Upper Latest Stone Age of North Africa," in *South-Eastern Mediterranean Peoples Between 130,000 and 10,000 Years Ago*. Edited by E. A. A. Garcea, pp. 54–65. Oxford: Oxbow.

Garfinkel, Y. 1993. The Yarmukian Culture in Israel. *Paléorient* 19:115–134.

Garfinkel, Y. 1994. "The PPNC Flint Assemblage from Tel 'Ali," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 543–565. Berlin: ex oriente.

Garfinkel, Y. Editor. 2002. *Sha'ar Hagolan Vol 1. Neolithic Art in Context*. Oxford, UK: Oxbow.

Garfinkel, Y. 2009. "The Neolithic-Chalcolithic Transition in the Southern Levant: The Material Culture Sequence," in *Transitions in Prehistory: Essays in Honor of Ofer Bar-Yosef.* Edited by J. J. Shea and D. E. Lieberman, pp. 325–334. Oxford, UK: Oxbow.

Garfinkel, Y., and D. Dag. Editors. 2006. *Gesher: A Pre-Pottery Neolithic A Site in the Central Jordan Valley, Israel: A Final Report.* Berlin: ex oriente.

Garfinkel, Y., and D. Dag. Editors. 2008. *Neolithic Ashkelon.* Jerusalem: Institute of Archaeology, Hebrew University.

Garrard, A. N., A. Betts, B. Byrd, and C. Hunt. 1988. "Summary of Palaeoenvironmental and Prehistoric Investigations in the Azraq Basin," in *The Prehistory of Jordan: The State of Research in 1986.* Edited by A. Garrard and H. G. Gebel, pp. 311–337. Oxford: British Archaeological Reports International Series 396 (ii).

Garrard, A. N., A. Pirie, B. Schroeder, and A. Wasse. 2003. Survey of Nachcharini Cave and prehistoric settlement in the northern Anti-Lebanon Highlands. *Bulletin d'Archeologie et d'Architecture Libanaises* 7:15–48.

Garrod, D. A. E. 1930. The Paleolithic of Southern Kurdistan: Excavations in the Caves of Zarzi and Hazar Merd. *Bulletin of the American School of Prehistoric Research* 6:8–43.

Garrod, D. A. E. 1932. A new Mesolithic industry: the Natufian culture of Palestine. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 62.

Garrod, D. A. E. 1937a. "El-Wad: Description and Archaeology," in *The Stone Age of Mount Carmel, Vol. 1: Excavations in the Wady el-Mughara.* Edited by D. A. E. Garrod and D. Bate, pp. 5–55. Oxford, UK: Clarendon Press.

Garrod, D. A. E. 1937b. "Et-Tabun: Description and Archaeology," in *The Stone Age of Mount Carmel, Vol. 1: Excavations in the Wady el-Mughara.* Edited by D. A. E. Garrod and D. Bate, pp. 57–70. Oxford, UK: Clarendon Press.

Garrod, D. A. E. 1937c. "The Near East as a Gateway of Prehistoric Migration," in *Early Man.* Edited by G. G. MacCurdy, pp. 33–40. New York: J. B. Lippincott Co.

Garrod, D. A. E. 1951. A transitional industry from the base of the Upper Paleolithic in Palestine. *Journal of the Royal Anthropological Institute* 80:121–130.

Garrod, D. A. E. 1955. Mugharet el-Emireh in the lower Galilee: Type-Station of the Emiran Industry. *Journal of the Royal Anthropological Institute* 85:141–162.

Garrod, D. A. E. 1956. Acheuléo-Jabroudien et "Pré-Aurignacien" de la grotte du Tabun (Mont Carmel). *Quaternaria* 3:39–59.

Garrod, D. A. E. 1957. Notes sur le paléolithique supérieur du Moyen Orient. *Bulletin de la Société Prehistorique Française* 54:439–446.

Garrod, D. A. E. 1962. The Middle Palaeolithic of the Near East and the Problem of Mount Carmel Man. *Journal of the Royal Anthropological Institute* 92:232–259.

Garrod, D. A. E., and D. M. A. Bate. Editors. 1937. *The Stone Age of Mount Carmel, Vol. 1: Excavations in the Wady el-Mughara*. Oxford: Clarendon Press.

Garrod, D. A. E., and D. M. A. Bate. 1942. Excavations at the Cave of Shukbah, Palestine. *Proceedings of the Prehistoric Society* 8:1–20.

Gebel, H. G., M. Muheisen, H. J. Nissen, and N. Qadi. 1998. "Late PPNB Basta: Results of 1992," in *Central Settlements in Neolithic Jordan*. Edited by H.-D. Beinert, H. G. Gebel, and R. Neef, pp. 71–104. Berlin: ex oriente.

Geneste, J.-M. 1985. Analyse lithique d'industries moustériennes du Périgord: approche technologique du comportement des groupes humaine au Paléolithique moyen. PhD thesis, Université de Bordeaux.

Gero, J. M. 1991. "Genderlithics: Women's Roles in Stone Tool Production," in *Engendering Archaeology: Women in Prehistory*. Edited by J. M. Gero and M. W. Conkey, pp. 163–193. Oxford: Blackwell.

Gilead, D. 1970. Handaxe Industries in Israel and the Near East. *World Archaeology* 2:1–11.

Gilead, I. 1981. The Upper Paleolithic of the Negev and Sinai. Doctoral Dissertation, Hebrew University.

Gilead, I. 1984. Palaeolithic sites in the northeastern Sinai. *Paléorient* 10:135–142.

Gilead, I. 1988. "The Upper Palaeolithic in the Southern Levant: Periodization and Terminology," in *Investigations in South Levantine Prehistory/Préhistoire du Sud-Levant*. Edited by O. Bar-Yosef and B. Vandermeersch, pp. 231–254. Oxford: British Archaeological Reports International Series 497.

Gilead, I. 1991. The Upper Paleolithic in the Levant. *Journal of World Prehistory* 5:105–154.

Gilead, I. 1995. "The Foragers of the Upper Paleolithic Period," in *Archaeology and Society in the Holy Land*. Edited by T. E. Levy, pp. 124–140. New York: Facts on File.

Gilead, I. 2009. "The Neolithic-Chalcolithic Transition in the Southern Levant: Late Sixth-Fifth Millennium Culture History," in *Transitions in Prehistory: Essays in Honor of Ofer Bar-Yosef*. Edited by J. J. Shea and D. E. Lieberman, pp. 335–356. Oxford, UK: Oxbow.

Gilead, I., and O. Bar Yosef. 1993. Early Upper Paleolithic Sites in the Qadesh Barnea Area, NE Sinai. *Journal of Field Archaeology* 20:265–280.

Gilead, I., and C. Grigson. 1984. Far'ah II: A Middle Palaeolithic open-air site in the Northern Negev, Israel. *Proceedings of the Prehistoric Society* 50:71–97.

Gilead, I., and D. Israel. 1975. An Early Paleolithic Site at Kefar Menahem: Preliminary Report. *Tel Aviv* 2:1–12.

Gillespie, J. D., S. Tupakka, and C. Cluney. 2004. Distinguishing Between Naturally and Culturally Flaked Cobbles: A Test Case from Alberta, Canada. *Geoarchaeology* 19:615–633.

Gisis, I., and O. Bar-Yosef. 1974. New Excavations in Zuttiyeh Cave. *Paléorient* 2:175–180.

Gisis, I., and A. Ronen. 2006. "Bifaces from Acheulian and Yabrudian layers of Tabun Cave, Israel," in *Axe Age: Acheulian Toolmaking from Quarry to Discard*. Edited by N. Goren-Inbar and G. Sharon, pp. 137–154. London: Equinox.

Golovanova, L., and V. Doronichev. 2003. The Middle Paleolithic of the Caucasus. *Journal of World Prehistory* 17:71–140.

Gopher, A. 1989. *The Flint Assemblages of Munhata (Israel). les Cahiers du Centre de Rechearche Français de Jérusalem 4*. Paris: Association Paléorient.

Gopher, A. 1994. *Arrowheads from the Neolithic Levant: A Seriation Analysis*. Winona Lake, IN: Eisenbrauns.

Gopher, A. 1997. "Groundstone Tools and Other Stone Objects from Netiv Hagdud," in *An Early Neolithic Village in the Jordan Valley. Part 1: The Archaeology of Netiv Hagdud*. Edited by O. Bar-Yosef and A. Gopher, pp. 151–176. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.

Gopher, A., O. Bar-Yosef, and D. Nadel. 1991. Early Neolithic arrowhead types in the Southern Levant: a typological suggestion. *Paléorient* 17:109–119.

Gopher, A., R. Barkai, R. Shimelmitz, M. Khalaidy, C. Lemorini, I. Hershkovitz, and M. Stiner. 2005. Qesem Cave: An Amudian Site in Central Israel. *Journal of the Israel Prehistoric Society* 35:62–92.

Gopher, A., and R. Gophna. 1993. Cultures of the eighth and seventh millenia BP in the Southern Levant: a review for the 1990s. *Journal of World Prehistory* 7:297–353.

Gopher, A., A. N. Goring-Morris, and D. Gordon. 1994. "Nahal Issaron. The Lithics of the Late PPNB Occupation," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 479–494. Berlin: ex oriente.

Goren-Inbar, N. 1985. The lithic assemblage of the Berekhat Ram Acheulian Site, Golan Heights. *Paléorient* 11:7–28.

Goren-Inbar, N. 1988. Too small to be true? Re-evaluation of cores on flakes in Levantine Mousterian assemblages. *Lithic Technology* 17:37–44.

Goren-Inbar, N. 1990a. "The Lithic Assemblages," in *Quneitra: A Mousterian Site on the Golan Heights*. Edited by N. Goren-Inbar, pp. 61–149. Jerusalem: Hebrew University Institute of Archaeology (Qedem 31).

Goren-Inbar, N. Editor. 1990b. *Quneitra: A Mousterian Site on the Golan Heights*. Jerusalem: Hebrew University Institute of Archaeology (Qedem No. 31).

Goren-Inbar, N. 1995. "The Lower Paleolithic of Israel," in *Archaeology of Society in the Holy Land*. Edited by T. E. Levy, pp. 93–109. New York: Facts on File.

Goren-Inbar, N., N. Alperson, M. E. Kislev, O. Simchoni, Y. Melamed, A. Ben-Nun, and E. Werker. 2004. Evidence of Hominin Control of Fire at Gesher Benot Ya'acov, Israel. *Science* 304:725–727.

Goren-Inbar, N., C. S. Feibel, K. L. Verosub, Y. Melamed, M. E. Kislev, E. Tchernov, and I. Saragusti. 2000. Pleistocene Milestones on the Out-of-Africa Corrdor at Gesher Benot Ya'aqov, Israel. *Science* 289:944–947.

Goren-Inbar, N., and I. Saragusti. 1996. An Acheulian Biface Assemblage from Gesher Benot Ya'acov, Israel: Indications of African Affinities. *Journal of Field Archaeology* 23:15–30.

Goren-Inbar, N., G. Sharon, N. Alperson-Afil, and I. Laschiver. 2008. The Acheulean massive scrapers of Gesher Benot Ya'aqov – a product of the biface chaîne opératoire. *Journal of Human Evolution* 55:702–712.

Goren-Inbar, N., G. Sharon, Y. Melamed, and M. Kislev. 2002. Nuts, nut cracking, and pitted stones at Gesher Benot Ya`aqov, Israel. *PNAS* 99:2455–2460.

Goren-Inbar, N., I. Zohar, and D. Ben-Ami. 1991. A new look at old cleavers – Gesher Benot Ya'aqov. *Mitekufat Haeven* 24:7–33.

Goring-Morris, A. N. 1980. Upper Palaeolithic sites from Wadi Fazael, Lower Jordan Valley`. *Paléorient* 6.

Goring-Morris, A. N. 1987. *At the Edge: Terminal Pleistocene Hunter-Gatherers in the Negev and Sinai*. Oxford: British Archaeological Reports International Series 361.

Goring-Morris, A. N. 1991. "The Harifian of the southern Levant," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 173–216. Ann Arbor, MI: Prehistory Press, International Monographs in Prehistory.

Goring-Morris, A. N. 1995a. Upper Palaeolithic occupation of the Ein Qadis area on the Sinai/Negev border. *'Atiqot* 27:1–14.

Goring-Morris, A. N. 1995b. "Complex Hunter/Gatherers at the end of the Paleolithic (20,000–10,000 BP)," in *Archaeology of Society in the Holy Land*. Edited by T. E. Levy, pp. 141–168. New York: Facts on File.

Goring-Morris, A. N. 2008. "Kefar Ha-Horesh," in *The New Encyclopedia of Archaeological Excavations in the Holy Land*, vol. 5. Edited by E. Stern, pp. 1907–1909. Jerusalem & Washington, D.C.: Israel Exploration Society and Biblical Archaeology Society.

Goring-Morris, A. N., and A. Belfer-Cohen. Editors. 2003. *More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East*. Oxford: Oxbow Books.

Goring-Morris, A. N., and A. Belfer-Cohen. 2011. Neolithization Processes in the Levant: The Outer Envelope. *Current Anthropology* 54: S208–S208

Goring-Morris, A. N. and A. Davidzon. 2006. Straight to the point: Upper Paleolithic Ahmarian lithic technology in the Levant. *Anthropologie* XLIV:93–111.

Goring-Morris, A. N., A. Gopher, and S. Rosen. 1994. "The Neolithic Tuwailian Cortical Knife Industry of the Negev, Israel," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 511–524. Berlin: ex oriente.

Goring-Morris, A. N., Y. Goren, L. K. Horwitz, I. Hershkovitz, R. Lieberman, J. Sarel, and D. Bar-Yosef. 1994–5. The 1992 season of excavations at the pre-Pottery Neolithic B settlement of Kfar Hahoresh. *Mitekufat Haeven, Journal of the Israel Prehistoric Society* 26:74–121.

Goring-Morris, A. N., E. Hovers, and A. Belfer-Cohen. 2009. "The Dynamics of Pleistocene and Early Holocene Settlement Patterns and Human Adaptations in the Levant: An Overview," in *Transitions in Prehistory: Essays in Honor of Ofer Bar-Yosef*. Edited by J. J. Shea and D. E. Lieberman, pp. 185–252. Oakville, CT: Oxbow.

Gould, R. A. 1980. *Living Archaeology*. Cambridge, UK: Cambridge University Press.

Grayson, D. K. 1986. "Eoliths, Archaeological Ambiguity, and the Generation of "Middle-Range" Research," in *American Archaeology Past and Future*. Edited by D. J. Meltzer, D. D. Fowler, and J. A. Sabloff, pp. 77–133. Washington, D.C.: Smithsonian Institution Press.

Groman-Yaruslavski, I., and D. Rosenberg. 2010. "The lithic assemblage (from Beisamun)," in *An Early Pottery Neolithic Occurrence at Beisamoun, The Hula Valley, Northern Israel: The Results of the 2007 Salvage Excavation*. Edited by D. Rosenberg, pp. 43–71. Oxford: BAR international series.

Grossman, L., A. Belfer-Cohen, and O. Bar-Yosef. 1999. A Final Natufian Site – Fazael IV. *Journal of the Israel Prehistoric Society* 29:17–40.

Grün, R., and C. Stringer. 2000. Tabun revisited: revised ESR chronology and new ESR and U-series analyses of dental material from Tabun C1. *Journal of Human Evolution* 39:601–612.

Güleç, E., F. C. Howell, and T. D. White. 1999. "Dursunlu – a new Lower Pleistocene faunal and artifact-bearing locality in southern Anatolia," in

Hominin Evolution – Lifestyles and Survival Strategies. Edited by H. Ullrich, pp. 349–364. Berlin: Edition Archaea.

Harris, J. W. K., and G. Isaac. 1997. "Sites in the Upper KBS, Okote, and Chari Members: Reports," in *Koobi Fora Research Project Series, Volume 5: Plio-Pleistocene Archaeology*. Edited by G. Isaac and B. Isaac, pp. 115–237. Oxford, UK: Clarendon.

Hayden, B. 1979. *Palaeolithic Reflections: Lithic Technology and Ethnographic Excavations among Australian Aborigines*. Canberra: Australian Institute of Aboriginal Studies.

Hayden, B. 1989. "From Chopper to Celt: The Evolution of Resharpening Techniques," in *Time, Energy and Stone Tools*. Edited by R. Torrence. Cambridge, UK: Cambridge University Press.

Henry, D. O. 1976. "Rosh Zin: A Natufian Settlement Near Ein Avdat," in *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. 1*. Edited by A. E. Marks, pp. 317–348. Dallas, TX: Southern Methodist University Press.

Henry, D. O. 1989. *From Foraging to Agriculture: The Levant at the End of the Ice Age*. Philadelphia: University of Pennsylvania Press.

Henry, D. O. 1995a. "Cultural-Historic Framework," in *Prehistoric Cultural Ecology and Evolution: Insights from Southern Jordan*. Edited by D. O. Henry, pp. 33–42. New York: Plenum.

Henry, D. O. 1995b. "The Middle Paleolithic Sites," in *Prehistoric Cultural Ecology and Evolution: Insights from Southern Jordan*. Edited by D. O. Henry, pp. 49–84. New York: Plenum.

Henry, D. O. Editor. 1995c. *Prehistoric Cultural Ecology and Evolution: Insights from Southern Jordan*. New York: Plenum.

Henry, D. O. Editor. 2003. *Neanderthals in the Levant: Behavioral Organization and the Beginnings of Human Modernity*. New York: Continuum.

Henry, D. O., C. Cordova, J. J. White, R. M. Dean, J. E. Beaver, H. Ekstrom, S. Kadowaki, J. McCorriston, A. Nowell, and L. Scott-Cummings. 2003. The Early Neolithic Site of Ayn Abu Nukhayla, Southern Jordan. *Bulletin of the American Schools of Oriental Research*:1–30.

Henshilwood, C. S., and C. W. Marean. 2003. The Origin of Modern Human Behavior. *Current Anthropology* 44:627–651.

Hodder, I. 2007. Catalhoyuk in the Context of the Middle Eastern Neolithic. *Annual Review of Anthropology* 36:105–120.

Holdaway, S. 1989. Were There Hafted Projectile Points in the Mousterian? *Journal of Field Archaeology* 16:79–85.

Holdaway, S., and M. Douglas. 2012. A Twenty-First Century Archaeology of Stone Artifacts. *Journal of Archaeological Method and Theory* 19:101–131.

Horowitz, A. 1979. *The Quaternary of Israel*. New York: Academic Press.

Horowitz, A. 1988. "Quaternary Environments and Paleogeography in Israel," in *The Zoogeography of Israel*. Edited by Y. Yom-Tov and E. Tchernov, pp. 35–58. Dordrecht: Junk.

Hours, F. 1974. Remarques sur l'utilisation de listes-types pour l'etude de Paléolithique supérieur et de l'Epipaléolithique du Levant. *Paléorient* 3:3–18.

Hours, F. 1975. "The Lower Paleolithic of Lebanon and Syria," in *Problems in Prehistory: North Africa and the Levant*. Edited by F. Wendorf and A. Marks, pp. 249–271. Dallas: SMU Press.

Hours, F. 1981. "Le Paléolithique inférieur de la Syrie et du Liban. Le point de la question en 1980," in *Préhistoire du Levant*. Edited by P. Sanlaville and J. Cauvin, pp. 165–184. Lyon: Maison de l'Orient.

Hours, F. 1986. *Le Paléolithique et l'Épipaléolithique de la Syrie et du Liban*. Beirut: Dar El-Marcho.

Hours, F., O. Aurenche, J. Cauvin, M.-C. Cauvin, L. Copeland, and P. Sanlaville. 1994. *Atlas des Sites au Proche-Orient (14000–5700 BP)*. Paris: Maison de l'Orient.

Hovers, E. 1998. "The Lithic Assemblages of Amud Cave: Implications for Understanding the End of the Mousterian in the Levant," in *Neandertals and Modern Humans in Western Asia*. Edited by T. Akazawa, K. Aoki, and O. Bar-Yosef, pp. 143–164. New York: Plenum.

Hovers, E. 2004. "Cultural Ecology at the Neandertal Site of Amud Cave, Israel," in *Archaeology and Paleoecology of Eurasia: Papers in Honor of Vadim Ranov*. Edited by A. P. Derevianko and T. I. Nokhrina, pp. 218–231. Novosibirsk, Russia: Institute of Archaeology and Ethnography SB RAS Press.

Hovers, E. 2007. "The many faces of cores-on-flakes: a perspective from the Levantine Mousterian," in *Tools versus Cores: Alternative Approaches to Stone Tool Analysis*. Edited by S. P. McPherron., pp. 42–73. Newcastle: Cambridge Scholars Press.

Hovers, E. 2009. *The Lithic Assemblages of Qafzeh Cave*. Oxford, UK: Oxford University Press.

Hovers, E., L. Kolska Horwitz, D. Bar-Yosef, and C. Cope-Miyashiro. 1988. The Site of Urkan e-Rub IIa: A Case Study of Subistence and Mobility Patterns in the Kebaran Period of the Lower Jordan Valley. *Mitekufat Haeven, Journal of the Israel Prehistoric Society* 21:20–48.

Howell, F. C. 1968. *Early Man*. New York: Time-Life Books.

Howell, N. 1986. Demographic Anthropology. *Annual Review of Anthropology* 15:219–246.

Hromnik, C. A. 1986. A Weighed View of the Weighted Digging Stick. *South African Archaeological Bulletin* 41:90–93.

Ibàñez, J. J. Editor. 2008. *Le site néolithique de Tel Mureybit (Syrie du Nord): En hommage à Jacques Cauvin*. Oxford: British Archaeological Reports International Series 1843 (2 volumes).

Inizan, M.-L., M. Reduron-Ballinger, H. Roche, and J. Tixier. 1999. *Technology and Terminology of Knapped Stone (translated by J. Féblot-Augustins). Préhistoire de la Pierre Taillée, Tome* 5. Meudon, FR: Cercle de Recherches et d'Etudes Préhistoriques (CNRS).

Inizan, M.-L., and J. Tixier. 2000. L'émergence des arts du feu: le traitement thermique des roches siliceuses. *Paléorient* 26:23–36.

Iovita, R. P. 2009. "Reevaluating Connections between the Early Upper Paleolithic of Northeast Africa and the Levant: Technological Differences between the Dabban and the Emiran," in *Transitions in Prehistory: Essays in Honor of Ofer Bar-Yosef*. Edited by J. J. Shea and D. E. Lieberman, pp. 125–142. Oxford, UK: Oxbow.

Isaac, G. L. 1986. "Foundation Stones: Early Artefacts as Indicators of Activities and Abilities," in *Stone Age Prehistory*. Edited by G. N. Bailey and P. Callow, pp. 221–241. Cambridge, UK: Cambridge University Press.

Jelinek, A. J. 1981. "The Middle Paleolithic of the Southern Levant from the Perspective of Tabun Cave," in *Préhistoire du Levant*. Edited by J. Cauvin and P. Sanlaville, pp. 265–280. Paris: Editions du CNRS.

Jelinek, A. J. 1982a. "The Middle Paleolithic in the Southern Levant with comments on the appearance of modern Homo sapiens," in *The Transition from Lower to Middle Paleolithic and the Origins of Modern Man*. Edited by A. Ronen, pp. 57–104. Oxford: British Archaeological Reports International Series 151.

Jelinek, A. J. 1982b. The Tabun Cave and Paleolithic man in the Levant. *Science* 216:1369–1375.

Johnson, L. L. 1978. A history of flint-knapping experimentation, 1838–1976. *Current Anthropology* 19:337–372.

Jones, M. L., A. E. Marks, and D. Kaufman. 1983. "Boker: The Artifacts," in *Prehistory and Paleoenvironments in the Central Negev, Israel. Volume III: the Avdat/Aqev Area, Part 3*. Edited by A. Marks, pp. 283–332. Dallas, TX: Southern Methodist University Press.

Jones, P. R. 1980. Experimental Butchery with Modern Stone Tools and Its Relevance for Palaeolithic Archaeology. *World Archaeology* 12:153–165.

Jones, P. R. 1994. "Results of experimental work in relation to the stone industries of Olduvai Gorge," in *Olduvai Gorge, Volume 5: Excavations in Beds III, IV and the Masek Beds, 1968–1971*. Edited by M. D. Leakey and D. A. Roe, pp. 254–298. Cambridge: Cambridge University Press.

Juel Jensen, H. 1988. Functional Analysis of Prehistoric Flint Tools by High-Power Microscopy. *Journal of World Prehistory* 2:53–88.

Julig, P. J., D. G. F. Long, H. B. Schroeder, W. J. Rink, D. Richter, H .P. Schwarcz. 1999. Geoarchaeology and New Research at Jerf al-Ajla Cave, Syria. *Geoarchaeology* 14: 821–848.

Kafafi, Z. A.-K. 2001. *Jebel Abu Thawwab (Er-Rumman), Central Jordan*. Berlin: ex oriente.

Kaplan, J. 1958. Excavations at Wadi Raba. *Israel Exploration Journal* 8: 149–160.

Kaplan, J. 1959. Excavations in Teluliot Batashi, Nahal Soreq. *Eretz-Israel* 5:9–54.

Kaufman, D. 1989. "Observations on the Geometric Kebaran: A view from Neve David.," in *Investigations in South Levantine Prehistory*, vol. 497. Edited by O. Bar-Yosef and B. Vandermeersch, pp. 275–284. Oxford: British Archaeological Reports International Series.

Keeley, L. H. 1980. *Experimental Determination of Stone Tool Uses: A Microwear Analysis*. Chicago: University of Chicago Press.

Keeley, L. H. 1982. Hafting and retooling: Effects on the archaeological record. *American Antiquity* 47:798–809.

Kelly, R. L. 1992. Mobility/sedentism: concepts, archaeological measures, and effects. *Annual Review of Anthropology* 21:43–66.

Kelly, R. L. 1995. *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Washington, D.C.: Smithsonian Institution Press.

Kenyon, K. M., and T. A. Holland. Editors. 1983. *Excavations at Jericho. Vol.* 5. London: The British School of Archaeology in Jerusalem.

Kerry, K. W. 1997. "Jebel Humeima: a Preliminary Lithic Analysis of an Ahmarian and Levantine Mousterian Site in Southwest Jordan," in *The Prehistory of Jordan, II. Perspectives from 1997*. Edited by H.-G. K. Gebel, Z. Kafafi, and G. Rollefson, pp. 125–136. Berlin: ex oriente.

Kerry, K. W., and D. Henry. 2003. "Tor Fawwaz (J403): An Upper Paleolithic Occupation in the Jebel Qalkha Area, Southwest Jordan," in *More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East*. Edited by A. N. Goring-Morris and A. Belfer-Cohen, pp. 171–184. Oxford: Oxbow Books.

Khalayla, H., and O. Marder. 2003. *The Neolithic Site of Abu Ghosh, the 1995 Excavation. Vol. 19. Israel Antiquities Authority Reports*. Jerusalem: Israel Antiquities Authority.

Kirkbride, D. 1958. A Kebaran Rock Shelter in Wadi Madamagh, Near Petra, Jordan. *Man* 58:55–58.

Kirkbride, D. 1966. Five seasons at the Pre-Pottery Neolithic village of Beidha in Jordan: A summary. *Palestine Exploration Quarterly* 98:8–72.

Kirkbride, D. 1969. Early Byblos and the Bakaa. *Mélanges de l'Université Saint-Joseph* 45:43–60.

Klein, R. G. 2009. *The Human Career, 3rd Edition*. Chicago: University of Chicago Press.

Klein, R. G., and B. Edgar. 2002. *The Dawn of Human Culture*. NY: Nevramont.

Knecht, H. Editor. 1997. *Projectile Technology*. New York: Plenum.

Kozlowski, S. K. 1989. Nemrik 9, a PPN Neolithic site in Northern Iraq. *Paléorient* 15:25–31.

Kozlowski, S. K. Editor. 1999. *The Eastern Wing of the Fertile Crescent: Late Prehistory of Greater Mesopotamian Lithic Industries*. British Archaeological Reports International Series S-760. Oxford, UK: Archaeopress.

Kozlowski, S. K., and O. Aurenche. 2005. *Territories, Boundaries and Cultures in the Neolithic Near East*. British Archaeological Reports International Series S1362. Oxford, UK: Archaeopress.

Kozlowski, S. K., and H. G. Gebel. 1994. "Editors' Concluding remarks on chipped lithics, techno-taxa and interaction spheres throughout the 9th to 6th Millennium," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 595–601. Berlin: ex oriente.

Kraybill, N. 1977. "Pre-Agricultural Tools or the Preparation of Foods in the Old World," in *Origins of Agriculture*. Edited by C. Reed, pp. 485–521. The Hague: Mouton.

Krebs, J. R., and N. B. Davies. 1991. *Behavioural Ecology: An Evolutionary Approach*, 3rd edition. London: Blackwell.

Kuhn, S. L. 1990. A geometrical index of reduction for unifacial stone tools. *Journal of Archaeological Science* 17:583–593.

Kuhn, S. L. 1993. "Mousterian Technology as Adaptive Response: A Case Study," in *Hunting and Animal Exploitation in the Later Paleolithic and Mesolithic of Eurasia*, Archaeological Paper No. 4. Edited by G. L. Peterkin, H. Bricker, and P. A. Mellars, pp. 25–48. Washington, D.C.: American Anthropological Association.

Kuhn, S. L. 1995. *Mousterian Lithic Technology: An Ecological Perspective*. Princeton, NJ: Princeton University Press.

Kuhn, S. L. 1996. The Trouble with Ham Steaks: A Reply to Morrow. *American Antiquity* 61:591–595.

Kuhn, S. L. 2003. "In what sense is the Levantine Initial Upper Paleolithic a "transitional" industry?," in *The Chronology of the Aurignacian and Transitional complexes. Dating, Stratigraphies and Cultural Implications*. Edited by J. Zilhao and F. d'Errico, pp. 61–68. Lisbon: Instituto Português Arqueologia (Trabajos de Arqueologia No. 33).

Kuhn, S. L. 2004. Evolutionary perspectives on technology and technological change. *World Archaeology* 36:561–570.

Kuhn, S. L., A. Belfer-Cohen, O. Barzilai, M. C. Stiner, K. W. Kerry, N. D. Munro, and D. B.-Y. M. D. 2004. The Last Glacial Maximum at Meged rockshelter, Upper Galilee. *Journal of the Israel Prehistoric Society* 34:5–47.

Kuhn, S. L., M. C. Stiner, E. Güleç, I. Özer, H. Yilmaz, I. Baykara, A. Açikkol, P. Goldberg, K. M. Molina, E. Ünay, and F. Suata-Alpaslan. 2009. The early Upper Paleolithic occupations at Uçagizli Cave (Hatay, Turkey). *Journal of Human Evolution* 56:87–113.

Kuijt, I. 2002. "Life in Neolithic Farming Communities," *Fundamental Issues in Archaeology*. Edited by I. Kuijt, pp. 3–13: Springer US.

Kuijt, I., and N. Goodale. 2006. Chronological frameworks and disparate technology: An exploration of chipped stone variability and the forager to farmer transition at 'Iraq ed-Dubb, Jordan. *Paléorient* 32:27–45.

Kuijt, I., and H. Mahasneh. 1998. Dhra': An Early Neolithic Village in the Southern Jordan Valley. *Journal of Field Archaeology* 25:153–161.

Landau, M. L. 1991. *Narratives of Human Evolution*. New Haven, CT: Yale University Press.

Larsen-Peterkin, G. 1993. "Lithic and Organic Hunting Technology," in *Hunting and Animal Exploitation in the Later Paleolithic and Mesolithic of Eurasia*. Edited by G. L. Peterkin, H. Bricker, and P. A. Mellars, pp. 49–68. Washington, D.C.: American Anthropological Association.

Larson, P. A., Jr. 1977. "Two Upper Paleolithic Sites in the Har Harif," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 173–190. Dallas: Southern Methodist University Press.

Lawrence, T. E. 1935. *Seven Pillars of Wisdom: A Triumph*. New York: Doubleday, Doran & Company.

Le Tensorer, J.-M. 2004. "Nouvelles fouilles à Hummal (El Kowm, Syrie centrale) premiers résultats (1997–2001)," in *From the River to the Sea The Paleolithic and the Neolithic on the Euphrates and in the Northern Levant. Studies in Honour of Lorraine Copeland*. Edited by O. Aurenche, M. Le Mière, and P. Sanlaville, pp. 223–240. Oxford, UK: British Archaeological Reports International Series S1263.

Le Tensorer, J.-M., R. Jagher, P. Rentzel, T. Hauck, K. Ismail-Meyer, C. Pümpin, and D. Wojtczak. 2007. Long-Term Site Formation Processes at the Natural Springs Nadaouiyeh and Hummal in the El Kowm Oasis, Central Syria. *Geoarchaeology* 22:621–639.

Le Tensorer, J. M., and F. Hours. 1989. "L'occupation d'un territoire a fin du Paléolithique ancien et au Paléolithique moyen a partir de l'exemple d'el Kowm (Syrie)," in *L'Homme de Néanderthal, Vol. 6*. Edited by M. Otte, pp. 107–114. Liége: Université de Liége.

Leakey, L. S. B. 1936. *Stone Age Africa*. London: Oxford University Press.

Leakey, L. S. B. 1960. *Adam's Ancestors (Fourth Edition)*. New York: Harper and Row.

Leakey, M. D. 1971. *Olduvai Gorge: Excavations in Beds I and II, 1960–1963*. Cambridge: Cambridge University Press.

Lechevallier, M., D. Philibert, A. Ronen, and A. Samzun. 1989. Une occupation Khiamienne et Sultanienne à Hatoula (Israël). *Paléorient* 15:1–10.

Lechevallier, M., and A. Ronen. Editors. 1994. *Le Gisement de Hatoula en Judée occidentale, Israël: rapport de fouilles 1980–1988. Mémoires et Travaux du Centre de Recherches Préhistoriques Français de Jérusalem* Jerusalem: Centre de Recherches Préhistoriques Français de Jérusalem

Lee, R. B. 1979. *The !Kung San: Men, Women and Work in a Foraging Society*. Cambridge: Cambridge University Press.

Lemmonier, P. 1986. The study of material culture today: Towards an anthropology of technical systems. *Journal of Anthropological Archaeology* 5:147–186.

Lengyel, G. 2007. *Upper Palaeolithic and Epipalaeolithic Lithic Technologies at Raqefet Cave, Mount Carmel East, Israel*. Oxford, UK: British Archaeological Reports International Series.

Leroi-Gourhan, A. 1993. *Gesture and Speech (Translated by Anna Bostock Berger)*. Cambridge, MA: MIT Press.

Levy, T. E., R. B. Adams, A. J. Witten, J. Anderson, Y. Arbel, S. Kuah, J. Mofeno, A. Lo, and M. Waggoner. 2001. Early Metallurgy, Interaction, and Social Change: The Jabal Hamrat Fidan (Jordan) Research Design and 1998 Archaeological Survey: Preliminary Report. *Annual of the Department of Antiquities of Jordan* 45:1–31.

Lindly, J. M. 2005. *The Mousterian of the Zagros: A Regional Perspective*. Tempe, AZ: Arizona State University (Anthropological Research Papers, No. 56).

Lindly, J. M., and G. A. Clark. 1987. A Preliminary Lithic Analysis of the Mousterian Site of 'Ain Difla (WHS Site 634) in the Wadi Ali, West-Central Jordan. *Proceedings of the Prehistoric Society* 53:279–292.

Loud, G. Editor. 1948. *Megiddo II (Seasons of 1935–39)*. Vol. 62. Chicago: Oriental Institute Publications.

Lubbock, J. 1865. *Pre-Historic Times, as Illustrated by Ancient Remains and the Manners and Customs of Modern Savages*. London: Williams and Norgate.

Lycett, S. J. 2008. Acheulean variation and selection: does handaxe symmetry fit neutral expectations? *Journal of Archaeological Science* 35:2640–2648.

Lycett, S. J., and C. J. Bae. 2010. The Movius Line controversy: the state of the debate. *World Archaeology* 42:521–544.

Lycett, S. J., N. von Cramon-Taubadel, and R. A. Foley. 2006. A cross-beam co-ordinate caliper for the morphometric analysis of lithic nuclei: a description, test and empirical examples of application. *Journal of Archaeological Science* 33:847–861.

Machin, A. J., R. T. Hosfield, and S. J. Mithen. 2007. Why are some handaxes symmetrical? Testing the influence of handaxe morphology on butchery effectiveness. *Journal of Archaeological Science* 34:883–893.

Macumber, P. G., and P. C. Edwards. 1997. "Preliminary results from the Acheulian Site of Mashari'a 1, and New Stratigraphic Framework for the Lower Palaeolithic of the East Jordan Valley," in *The Prehistory of Jordan, II. Perspectives from 1997*. Edited by H.-G. K. Gebel, Z. Kafafi, and G. Rollefson, pp. 23–44. Berlin: ex oriente.

Madsen, B., and N. Goren-Inbar. 2004. Acheulian giant core technology and beyond: an archaeological and experimental case study. *Eurasian Prehistory* 2:3–52.

Maher, L. A., M. Lohr, M. Betts, C. Parslow, and E. B. Banning. 2001. Middle Epipalaeolithic Sites in Wadi Ziqlab, Northern Jordan. *Paléorient* 27:5–19.

Maher, L. A., T. Richter, D. Macdonald, M. D. Jones, L. Martin, and J. T. Stock. 2012. Twenty Thousand-Year-Old Huts at a Hunter-Gatherer Settlement in Eastern Jordan. *PLoS ONE* 7:e31447.

Maher, L. A., T. Richter, and J. T. Stock. 2012. The Pre-Natufian Epipaleolithic: Long-Term Behavioral Trends in the Levant. *Evolutionary Anthropology* 21:69–81.

Marder, O., G. Gvirtzman, H. Ron, H. Khalaily, M. Wieder, R. Bankirker, R. Rabinovich, N. Porat, and I. Saragusti. 1999. The Lower Paleolithic site of Revadim Quarry, preliminary finds. *Journal of the Israel Prehistoric Society* 28:21–53.

Marder, O., A. Malinsky-Buller, R. Shahack-Gross, O. Ackermann, A. Ayalon, M. Bar-Matthews, Y. Goldsmith, M. Inbar, R. Rabinovich, and E. Hovers. 2011. Archaeological horizons and fluvial processes at the Lower Paleolithic open-air site of Revadim (Israel). *Journal of Human Evolution* 60:508–522.

Marder, O., I. Mielvski, and Z. Matskevich. 2006. "The handaxes of Revadim Quarry: typo-technological considerations and aspects of intra-site variability," in *Axe Age: Acheulian Toolmaking from Quarry to Discard*. Edited by N. Goren-Inbar and G. Sharon, pp. 223–242. London: Equinox.

Marks, A. E. 1976a. "Ein Aqev: A Late Levantine Upper Paleolithic Site in the Nahal Aqev," in *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. 1*. Edited by A. E. Marks, pp. 227–292. Dallas, TX: Southern Methodist University Press.

Marks, A. E. 1976b. "Glossary," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 1: The Avdat/Aqev Area*. Edited by A. E. Marks, pp. 371–383. Dallas: Southern Methodist University Press.

Marks, A. E. Editor. 1976c. *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 1: The Avdat/Aqev Area, Part 1*. Dallas, TX: Southern Methodist University Press.

Marks, A. E. 1976d. "Site D5: A Geometric Kebaran 'A' Occupation in the Nahal Zin," in *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. 1*. Edited by A. E. Marks, pp. 293–316. Dallas, TX: Southern Methodist University Press.

Marks, A. E. Editor. 1977a. *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2, the Avdat/Aqev Area, Part 2*. Dallas, TX: Southern Methodist University Press.

Marks, A. E. 1977b. "The Upper Paleolithic Sites of Boker Tachtit and Boker: A Preliminary Report," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 61–79. Dallas: Southern Methodist University Press.

Marks, A. E. 1981. "The Upper Paleolithic of the Negev," in *Préhistoire du Levant*. Edited by J. Cauvin, pp. 299–304. Lyon: CNRS.

Marks, A. E. 1983a. "The Sites of Boker Tachtit and Boker: A Brief Introduction," in *Prehistory and Paleoenvironments in the Central Negev, Israel*, vol. 3: The Avdat/Aqev Area (Part 3). Edited by A. Marks, pp. 15–37. Dallas, TX: Southern Methodist University Press.

Marks, A. E. 1983b. "The Middle to Upper Paleolithic Transition in the Levant," in *Advances in World Archaeology*, vol. 2. Edited by F. Wendorf and A. E. Close, pp. 51–98. New York: Academic Press.

Marks, A. E. 1992. "Typological variability in the Levantine Middle Paleolithic," in *The Middle Paleolithic: Adaptation, Behavior and Variability*. Edited by H. L. Dibble and P. A. Mellars, pp. 127–141. Philadelphia: University of Pennsylvania Museum Press.

Marks, A. E., and C. R. Ferring. 1976. "Upper Paleolithic Sites near Ein Avdat," in *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. 1*. Edited by A. E. Marks, pp. 141–198. Dallas, TX: Southern Methodist University Press.

Marks, A. E., and D. Kaufman. 1983. "Boker Tachtit: the Artifacts," in *Prehistory and Paleoenvironments in the Central Negev, Israel*, vol. 3: The Avdat/Aqev Area (Part 3). Edited by A. Marks, pp. 69–126. Dallas, TX: Southern Methodist University Press.

Marks, A. E., and P. A. Larson, Jr. 1977. "Test Excavations at the Natufian Site of Rosh Horesha," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 191–232. Dallas: Southern Methodist University Press.

Marks, A. E., and A. H. Simmons. 1977. "The Negev Kebaran of the Har Harif," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol.*

2: The Avdat/Aqev Area, Part 2 and the Har Harif. Edited by A. E. Marks, pp. 233–270. Dallas: Southern Methodist University Press.

Marks, A. E., and P. Volkman. 1986. The Mousterian of Ksar Akil: Levels XXVIA through XXVIIIB. *Paléorient* 12:5–20.

Mazurowski, R. F., D. J. Michczynska, A. Pazdur, and N. Piotrowska. 2009. Chronology of the Early Pre-Pottery Neolithic Settlement Tell Qaramel, Northern Syria, in the Light of Radiocarbon Dating. *Radiocarbon* 51:771–781.

McBrearty, S. 2007. "Down with the Revolution," in *Rethinking the Human Revolution*. Edited by P. Mellars, K. Boyle, O. Bar-Yosef, and C. Stringer, pp. 133–152. Cambridge, UK: McDonald Institute for Archaeological Research Monographs.

McBrearty, S., and A. S. Brooks. 2000. The Revolution That Wasn't: a New Interpretation of the Origin of Modern Human Behavior. *Journal of Human Evolution* 39:453–563.

McCown, T. D. 1937. "Mugharet es-Skhul. Description and Excavations.," in *The Stone Age of Mount Carmel, Vol. 1: Excavations in the Wady el-Mughara*. Edited by D. Garrod and D. M. A. Bate, pp. 91–112. Oxford: Clarendon Press.

McGarry, S., M. Bar-Matthews, A. Matthews, A. Vaks, B. Schilman, and A. Ayalon. 2004. Constraints on hydrological and paleotemperature variations in the Eastern Mediterranean region in the last 140 ka given by the [delta]D values of speleothem fluid inclusions. *Quaternary Science Reviews* 23:919–934.

McPherron, S. 2006. "What typology can tell us about Acheulian handaxe production," in *Axe Age: Acheulian Toolmaking from Quarry to Discard*. Edited by N. Goren-Inbar and G. Sharon, pp. 267–286. London: Equinox.

Meignen, L. 1996. "Les prémices du Paléolithique supérieur au Proche-Orient," in *The Last Neandertals, The First Anatomically Modern Humans: A Tale about Human Diversity. Cultural Change and Human Evolution: The Crisis at 40 KA BP*. Edited by E. Carbonell and M. Vaquero, pp. 107–128. Barcelona: Grafiques Lluc.

Meignen, L. 1998. "Hayonim Cave Lithic Assemblages in the Context of the Near Eastern Middle Paleolithic: A Preliminary Report," in *Neandertals and Modern Humans in Western Asia*. Edited by T. Akazawa, K. Aoki, and O. Bar-Yosef, pp. 165–180. New York: Plenum.

Meignen, L. 2000. Early Middle Paleolithic Blade Technology in Southwestern Asia. *Acta Anthropologica Sinica* 19:158–168/170–180.

Meignen, L., and O. Bar-Yosef. 1988. Kebara et le Paléolithique moyen du Mont Carmel (Israël). *Paléorient* 14:123–130.

Meignen, L., and O. Bar-Yosef. 1992. "Middle Paleolithic Lithic Variability in Kebara Cave, Mount Carmel, Israel," in *The Evolution and Dispersal of*

Modern Humans in Asia. Edited by T. Akazawa, K. Aoki, and T. Kimura, pp. 129–148. Tokyo: Hokusen-sha.

Mellars, P. 1989. Major issues in the emergence of modern humans. *Current Anthropology* 30:349–385.

Mellars, P. 2006. Archaeology and the Dispersal of Modern Humans in Europe: Deconstructing the "Aurignacian." *Evolutionary Anthropology* 15:167–182.

Mellars, P. 2007. "Rethinking the Human Revolution: Eurasian and African Perspectives," in *Rethinking the Human Revolution*. Edited by P. Mellars, K. Boyle, O. Bar-Yosef, and C. Stringer, pp. 1–14. Cambridge, UK: McDonald Institute for Archaeological Research Monographs.

Mercier, N., and H. Valladas. 2003. Reassessment of TL age estimates of burnt flints from the Paleolithic site of Tabun Cave, Israel. *Journal of Human Evolution* 45:401–409.

Mithen, S. 2004. *After the Ice: A Global Human History, 20,000–5000 BC*. Cambridge, MA: Harvard University Press.

Molist, M., and F. Borrell. 2007. Projectile Points, Sickle Blades and Glossed Points. Tools and Hafting Systems at Tell Halula (Syria) during the 8th millennium cal. BC. *Paléorient* 33:59–77.

Monigal, K. 2001. Lower and Middle Paleolithic Blade Industries and the Dawn of the Upper Paleolithic in the Levant. *Archaeology, Ethnology, and Anthropology of Eurasia* 1:11–24.

Moore, A. M. T., Hillman, Gordon C., and Legge, Anthony J. Editor. 2000. *Village on the Euphrates: From Foraging to Farming at Abu Hureyra*. Oxford, UK: Oxford University Press.

Mortensen, P. 1970. A Preliminary Study of the Chipped Stone Industry from Beidha, an Early Neolithic Village in Southern Jordan. *Acta Archaeologica* 41:1–54.

Muheisen, M., H. G. Gebel, C. Hannss, and R. Neef. 1988. "'Ain Rahub, a new Final Natufian and Yarmoukian site near Irbid," in *The Prehistory of Jordan*. Edited by A. Garrard and H. G. Gebel, pp. 472–502. Oxford: British Archaeological Reports International Series (No. 396).

Muhesen, S. 1985. *L'Acheuléen récent évolué de Syrie*. Oxford, UK: British Archaeological Reports International Series 248.

Muhesen, S. 1988. Le Paléolithique inférieur de Syrie. *L'Anthropologie* 92:863–882.

Muhesen, S. 1998. "The Earliest Paleolithic Occupation in Syria," in *Neandertals and Modern Humans in Western Asia*. Edited by T. Akazawa, K. Aoki, and O. Bar-Yosef, pp. 95–106. New York: Plenum.

Munday, F. C. 1976. "Intersite variability in the Mousterian occupation of the Avdat/Aqev area," in *Prehistory and Paleoenvironments of the Central Negev,* *Israel, Vol. 1*. Edited by A. E. Marks, pp. 57–68. Dallas, TX: Southern Methodist University Press.

Munday, F. C. 1977. "Nahal Aqev (D35): A stratified, open-air Mousterian Occupation in the Avdat/Aqev Area," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 35–60. Dallas: Southern Methodist University Press.

Nadel, D. 1994. "New Symmetry of Early Neolithic Tools: Arrowheads and Truncated Elements," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 407–422. Berlin: ex oriente.

Nadel, D. 1997. "The Chipped Stone Industry of Netiv Hagdud," in *An Early Neolithic Village in the Jordan Valley. Part 1: The Archaeology of Netiv Hagdud*. Edited by O. Bar-Yosef and A. Gopher, pp. 71–149. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.

Nadel, D. Editor. 2002. *Ohalo II, A 23,000-Year-Old Fisher-Hunter-Gatherers' Camp on the Shore of the Sea of Galilee*. Haifa, Israel: Reuben and Edith Hecht Museum, University of Haifa.

Nadel, D., and Y. Garfinkel. 1989. The Sultanian flint assemblage from Gesher and its implications for recognizing Early Neolithic entities in the Levant. *Paléorient* 15:139–151.

Nelson, M. C. 1988. "The Study of Technological Organization," in *Archaeological Method and Theory*, vol. 3. Edited by M. B. Schiffer, pp. 57–100. Tucson: University of Arizona Press.

Neuville, R. 1934. Le Préhistorique de Palestine. *Revue Biblique* 43:237–259.

Neuville, R. 1951. *Le Paléolithique et le Mésolithique de Désert de Judée*. Vol. Mémoire 24. *Archives de L'Institut de Paléontologie Humaine Mémoire 24*. Paris: Masson et Cie, Editeurs.

Newcomer, M. H. 1970. The chamfered pieces from Ksar Akil (Lebanon). *Bulletin of the Institute of Archaeology, University of London* 8–9:177–191.

Newcomer, M. H. 1984. Bone artifacts from Ksar Akil, Lebanon. *Paléorient* 10:143–147.

Newcomer, M. H. 1988. "The Chamfered Pieces from Ksar Akil (Lebanon)," in *Ksar Akil, Lebanon: A Technological Study of the Earlier Upper Palaeolithic Levels of Ksar Akil Volume III: Levels XXV–XIV*. Edited by K. Ohnuma, pp. 297–312. Oxford, UK: British Archaeological Reports International Series 426.

Nierlé, M. C. 2008. "L'outillage de mouture et du broyage," in *Le site néolithique de Tel Mureybit (Syrie du Nord): En hommage à Jacques Cauvin*, vol. 2. Edited by J. J. Ibàñez, pp. 539–568. Oxford: British Archaeological Reports International Series 1843 (2 volumes).

Nishiaki, Y. 1985. Truncated-facetted flakes from Levantine Mousterian assemblages. *Bulletin of the Department of Archaeology, University of Tokyo* 4:215–226.

Nishiaki, Y. 1987. "Middle Paleolithic assemblages from the Douara Cave, 1984 Excavation," in *Paleolithic Site of Douara Cave and Paleogeography of the Palmyra Basin in Syria, Part IV: 1984 Excavations*. Edited by T. Akazawa and Y. Sakaguchi, pp. 61–96. Tokyo: University of Tokyo Museum Bulletin No. 29.

Nishiaki, Y. 2000. *Lithic Technology of Neolithic Syria. BAR International Series 840*. Oxford.

Nishiaki, Y., and L. Copeland. 1992. "Keoue Cave, Northern Lebanon, and Its Place in the Context of the Levantine Mousterian," in *The Evolution and Dispersal of Modern Humans in Asia*. Edited by T. Akazawa, K. Aoki, and T. Kimura, pp. 107–128. Tokyo: Hokusen-sha.

Nowell, A. 2010. Defining Behavioral Modernity in the Context of Neandertal and Anatomically Modern Human Populations. *Annual Review of Anthropology* 39:437–452.

Noy, T. 1994. "The Gilgal Truncation. A New Type of Tool from Early PPNA," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 423–426. Berlin: ex oriente.

Noy, T., A. J. Legge, and E. S. Higgs. 1973. Recent Excavations in Nahal Oren, Israel. *Proceedings of the Prehistoric Society* 39:75–99.

Nunn, C. L. 2011. *The Comparative Approach in Evolutionary Anthropology and Biology*. Chicago, IL: University of Chicago Press.

O'Brien, E. M. 1981. The projectile capabilities of an Acheulian Handaxe from Olorgesailie. *Current Anthropology* 22:76–79.

Odell, G. H. 1981. The Morphological Express at Function Junction: Searching for Meaning in Lithic Tool Types. *Journal of Anthropological Research* 37:319–342.

Odell, G. H. 2001. Stone Tool Research at the End of the Millennium: Classification, Function, and Behavior. *Journal of Archaeological Research* 9:45–100.

Odell, G. H. 2004. *Lithic Analysis*. New York: Kluwer.

Ohnuma, K. 1989. *Ksar Akil, Lebanon: A Technological Study of the Earlier Upper Paleolithic Levels of Ksar Akil. Volume 3: Levels XXV–XIV*. Oxford, UK: British Archaeological Reports International Series 426.

Olszewski, D. I. 1986. *The North Syrian Late Epipaleolithic: The Earliest Occupation at Tell Abu Hureyra in the Context of the Levantine Late Epipaleolithic*. Vol. 309. Oxford, UK: British Archaeological Reports International Series.

Olszewski, D. I. 1993. "The Late Baradostian Occupation of Warwasi Rockshelter, Iran," in *The Paleolithic Prehistory of the Zagros-Taurus*. Edited by

D. Olszewski and H. Dibble, pp. 185–206. Philadelphia, PA: University of Pennsylvania Museum Press.

Olszewski, D. I. 1994. "The PPNC Flint Assemblage from Tel 'Ali," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 467–478. Berlin: ex oriente.

Olszewski, D. I. 1997. "From the Late Ahmarian to the Early Natufian. A Summary of Hunter-Gatherer Activities at Yutil al-Hasa, West-Central Jordan," in *The Prehistory of Jordan, II. Perspectives from 1997*. Edited by H.-G. K. Gebel, Z. Kafafi, and G. Rollefson, pp. 171–182. Berlin: ex oriente.

Olszewski, D. I. 2006. Issues in the Levantine Epipaleolithic: The Madamaghan, Nebekian, and Qalkhan (Levantine Epipaleolithic). *Paléorient* 32:19–26.

Olszewski, D. I., G. A. Clark, and S. K. Fish. 2000. "WHS 784 (Yutil al-Hasa): A Late Ahmarian Site in the Wadi Hasa, West-Central Jordan," in *The Archaeology of the Wadi al-Hasa, West-Central Jordan, Volume 2: Excavations at Middle, Upper, and Epipaleolithic Sites*. Edited by N. Coinman, pp. 195–210. Tempe, AZ: Arizona State University Anthropological Research Papers, No. 52.

Olszewski, D. I., and H. Dibble. 1994. The Zagros Aurignacian. *Current Anthropology* 35:68–75.

Olszewski, D. I., and H. Dibble. 2002. "To be or not to be Aurignacian," in *Toward a Definition of the Aurignacian*. Edited by O. Bar-Yosef and J. Zilhao, pp. 355–373. Oxford: Oxbow Books.

Oswalt, W. H. 1973. *Habitat and Technology: The Evolution of Hunting*. New York: Holt, Rinehart, and Winston.

Otte, M. 2008. "Turkey, Paleolithic Cultures," in *Encyclopedia of Archaeology*. Edited by D. Pearsall, pp. 904–908. New York: Academic Press.

Otte, M., I. Yalcinkaya, J. Kozlowski, O. Bar-Yosef, I. L. Bayon, and H. Taskiran. 1998a. Long-term technical evolution and human remains in the Anatolian Paleolithic. *Journal of Human Evolution* 34:413–431.

Otte, M., I. Yalçinkaya, J. Kozlowski, O. Bar-Yosef, I. Lopez Bayón, and H. Taskiran. 1998b. Long-term technical evolution and human remains in the Anatolian Palaeolithic. *Journal of Human Evolution* 34:413–431.

Otte, M., I. Yalçinkaya, J. Kozlowski, O. Bar-Yosef, H. Taskiran, and P. Noiret. 1995. Évolution technique au paléolithique ancien de Karaïn (Turquie). *L'Anthropologie* 99:529–561.

Parry, W. A., and R. L. Kelly. 1987. "Expedient Core Technology and Sedentism," in *The Organization of Core Technology*. Edited by J. K. Johnson and C. A. Morrow, pp. 285–304. Boulder, CO: Westview Press.

Pastoors, A., J.-C. Weniger, and J. F. Kegler. 2008. The Middle – Upper Palaeolithic Transition at Yabroud II (Syria). A Re-evaluation of the Lithic Material from the Rust Excavation. *Paléorient* 34:47–65.

Patterson, L. W. 1983. Criteria for determining the attributes of man-made lithics. *Journal of Field Archaeology* 10:296–307.

Peacock, E. 1991. Distinguishing between artifacts and geofacts: A test case from eastern England. *Journal of Field Archaeology* 18:345–361.

Perrot, J. 1955. Le Paléolithique supérieur de 'El Quseir et de Masraq an Ja'aj (Paléstine). Inventoire de la collection René Neuville I et II. *Bulletin de la société Préhistorique Française* 52:502–506.

Perrot, J. 1968. *La Préhistoire Palestinienne. Supplément au dictionnaire de la Bible, Tome VIII, No. 43*. Paris: Letouzey et Ane.

Peterson, J. 1999. Early Epipaleolithic Settlement Patterns: Insights from the Study of Ground Stone Tools from the Southern Levant. *Levant* 31:1–17.

Phillips, J. L. 1988. The Upper Paleolithic of the Wadi Feiran, southern Sinai. *Paléorient* 14:183–200.

Phillips, J. L., and I. N. Saca. 2002. Recent excavations at the site of Erq-el-Ahmar. *Antiquity* 76:17–18.

Pianka, E. R. 1988. *Evolutionary Ecology*, 4th edition. New York: Harper and Row.

Pigeot, N. 1990. Technical and social actors: Flintknapping specialists and apprentices at Magdalenian Etiolles. *Archaeological Review from Cambridge* 9:126–141.

Pleurdeau, D., N. Touchabramichvili, M. Nioradze, H. de Lumley, and D. Lordkipanidze. 2007. Les assemblages lithiques du Paléolithique moyen de Georgie. *L'Anthropologie Mousterien* 111:400–431.

Ploux, S., and S. Soriano. 2003. Umm el Tlel, une séquence du Paléolithique supérieur en Syrie centrale. Industries lithiques et chronologie culturelle. *Paléorient* 29:5–34.

Plummer, T. 2004. Flaked Stone and Old Bones: Biological and Cultural Evolution at the Dawn of Technology. *Yearbook of Physical Anthropology* 47:118–164.

Porat, N., M. Chazan, H. Schwarcz, and L. Kolska Horowitz. 2002. Timing of the Lower to Middle Paleolithic Boundary: New Dates from the Levant. *Journal of Human Evolution* 43:107–122.

Potts, R. 1988. *Early Hominid Activities at Olduvai*. New York: Aldine de Gruyter.

Potts, R. 1996. *Humanity's Descent: The Consequences of Ecological Instability*. New York, NY: William Morrow and Co.

Potts, R. 1998. Variability Selection and Hominid Evolution. *Evolutionary Anthropology* 7:81–96.

Price, T. D., and O. Bar-Yosef. 2011. The Origins of Agriculture: New Data, New Ideas: An Introduction to Supplement 4. *Current Anthropology* 52:S174–S174.

Quintero, L. A. 2011. *Evolution of Lithic Economies in the Levantine Neolithic: Development and Demise of Naviform Core Technology, as Seen at 'Ain Ghazal ('Ain Ghazal Excavation Reports 2)*. Berlin: ex orienté.

Richerson, P., R. Boyd, and R. L. Bettinger. 2001. Was Agriculture Impossible during the Pleistocene but Mandatory during the Holocene? A Climate Change Hypothesis. *American Antiquity* 66:387–411.

Rink, W. J., H. P. Schwarcz, A. Ronen, and A. Tsatskin. 2004. Confirmation of a near 400 ka age for the Yabrudian industry at Tabun Cave, Israel. *Journal of Archaeological Science* 31:15–20.

Roe, D. A. Editor. 1983. *Adlun in the Stone Age. BAR International Series*. Oxford, UK: British Archaeological Reports.

Rolland, N. 1981. The Interpretation of Middle Paleolithic Variability. *Man* 16:15–42.

Rolland, N., and H. L. Dibble. 1990. A New Synthesis of Middle Paleolithic Variability. *American Antiquity* 55:480–499.

Rollefson, G. 1980. The Paleolithic industries of Ain-el-Assad (Lion's Spring), near Azraq, Eastern Jordan. *Annual of the Department of Antiquities, Jordan* XXIV:129–143, 301–309.

Rollefson, G. 1994. Protocols of the First Workshop on PPN Chipped Lithics Industries, Berlin, 29 March – 2 April 1993. *Neo-Lithics* 1:1–5.

Rollefson, G., D. Schnurrenberger, L. Quintero, R. Watson, and R. Low. 1997. "'Ain Soda and 'Ain Qasiya: New Late Pleistocene and Early Holocene Sites in the Azraq Shishan Area, Eastern Jordan.," in *The Prehistory of Jordan, II. Perspectives from 1997*. Edited by H.-G. K. Gebel, Z. Kafafi, and G. Rollefson, pp. 45–58. Berlin: ex oriente.

Rollefson, G., A. H. Simmons, and Z. Kafafi. 1992. Neolithic Cultures at 'Ain Ghazal, Jordan. *Journal of Field Archaeology* 19:443–470.

Ron, H., N. Porat, A. Ronen, E. Tchernov, and L. K. Horwitz. 2003. Magnetostratigraphy of the Evron Member–implications for the age of the Middle Acheulian site of Evron Quarry. *Journal of Human Evolution* 44:633–639.

Ronen, A. 1974. *Tirat Carmel: A Mousterian Open-Air Site in Israel*. Tel Aviv: Tel Aviv University Institute of Archaeology, Publication No. 3.

Ronen, A. Editor. 1984. *Sefunim Prehistoric Sites, Mount Carmel, Israel*. Oxford: British Archaeological Reports International Series 230.

Ronen, A. 1991. The Yiron-Gravel lithic assemblage: Artifacts older than 2.4 My in Israel. *Archäologisches Korrespondenzblatt* 21:159–165.

Ronen, A. 2006. The oldest human groups in the Levant. *Comptes Rendus Palevol* 5:343–351.

Ronen, A., D. Gilead, E. Shachnai, and A. Saull. 1972. Upper Acheulean in the Kissufim Region. *Proceedings of the American Philosophical Society* 116:68–96.

Roodenberg, J. 1986. *Le mobilier en pierre de Bouqras. Utilisation de la pierre dans un site néolithique sur le Moyen Euphrate (Syrie)*. Leiden: Nederlands Historisch-Archaeologisch Instituut.

Rosen, S. A. 1996. "The Decline and Fall of Flint," in *Stone Tools: Theoretical Insights into Human Prehistory*. Edited by G. H. Odell, pp. 129–158. New York: Plenum.

Rosen, S. A. 1997. *Lithics after the Stone Age: a Handbook of Stone Tools from the Levant*. Walnut Creek, CA.: AltaMira Press.

Rosenberg, D. 2010. Early Maceheads in the Southern Levant: A "Chalcolithic" Hallmark in Neolithic Contex. *Journal of Field Archaeology* 35:204–216.

Rosenberg, M., and R. Redding. 2002. "Hallan Çemi and Early Village Organization in Eastern Anatolia Life in Neolithic Farming Communities," *Fundamental Issues in Archaeology*. Edited by I. Kuijt, pp. 39–62: Springer US.

Rust, A. 1950. *Die Höhlenfunde von Jabrud (Syrien)*. Neumünster: K. Wacholtz.

Sackett, J. R. 1982. Approaches to style in lithic archaeology. *Journal of Anthropological Archaeology* 1:59–112.

Sackett, J. R. 1991. "Straight Archaeology French Style: The Phylogenetic Paradigm in Historical Perspective," in *Perspectives on the Past: Theoretical Biases in Mediterranean Hunter-Gatherer Research*. Edited by G. Clark, pp. 109–139. Philadelphia: University of Pennsylvania Press.

Sahnouni, M. 1997. An Experimental Investigation into the Nature of Faceted Limestone "Spheroids" in the Early Paleolithic. *Journal of Archaeological Science* 24.

Sánchez Priego, J. A. 2008. "Analyse technologique et fonctionelle des herminettes de Mureybit," in *Le site néolithique de Tel Mureybit (Syrie du Nord): En hommage à Jacques Cauvin*, vol. 1. Edited by J. J. Ibàñez, pp. 407–435. Oxford: British Archaeological Reports International Series 1843 (2 volumes).

Sanlaville, P., J. Besançon, L. Copeland, and S. Muhesen. Editors. 1993. *Le Paléolithique de la vallée moyenne de l'Oronte (Syrie)*. Oxford, UK: British Archaeological Reports International Series 587.

Schick, K. D., and N. Toth. 1994. "Early Stone Age technology in Africa: A review and case study into the nature and function of spheroids and subspheroids," in *Integrative Paths to the Past: Paleoanthropological Advances in Honor of F. Clark Howell*. Edited by S. C. Robert and R. L. Ciochon, pp. 429–449. Englewood Cliffs, NJ: Prentice-Hall.

Schick, T., and M. Stekelis. 1977. Mousterian Assemblages in Kebara Cave, Mount Carmel. *Eretz Israel* 13 (M. Stekelis Memorial Volume):97–150.

Schiffer, M. B. 1987. *Formation Processes of the Archaeological Record*. Albuquerque, NM: University of New Mexico Press.

Schild, R., and F. Wendorf. 2010. "Late Palaeolithic hunter-gatherers in the Nile Valley of Nubia and Upper Egypt," in *South-Eastern Mediterranean Peoples Between 130,000 and 10,000 Years Ago*. Edited by E. A. A. Garcea, pp. 89–125. Oxford: Oxbow.

Schmidt, K. 1994. "The Nevali Çori Industry," in *Neolithic Chipped Stone Industries of the Fertile Crescent: Proceedings of the First Workshop on PPN Chipped Lithic Industries*. Edited by H. G. Gebel and S. K. Kozlowski, pp. 239–252. Berlin: ex oriente.

Schmidt, K. 2000. Göbekli Tepe, Southeastern Turkey. A Preliminary Report on the 1995–1999 Excavations. *Paléorient* 26:45–54.

Schroeder, H. B. 1991. "Natufian in the Central Béquaa Valley, Lebanon," in *The Natufian Culture in the Levant*. Edited by O. Bar-Yosef and F. R. Valla, pp. 43–80. Madison, WI: International Monographs in Prehistory.

Schroeder, H. B. 2007. "Truncated-facetted pieces from Jerf al-Ajla," in *Tools versus Cores: Alternative Approaches to Stone Tool Analysis*. Edited by S. McPherron, pp. 17–41. Newcastle: Cambridge Scholars Publishing.

Schwarcz, H. P., P. Goldberg, and B. Blackwell. 1980. Uranium Series Dating of Archaeological Sites in Israel. *Israel Journal of Earth Sciences* 29:157–165.

Schwartz, J. 1999. Can We Really Identify Species, Living or Extinct? *Anthropologie* 37:211–220.

Schyle, D., and H.-P. Uerpmann. 1988. "Paleolithic sites in the Petra Area," in *The Prehistory of Jordan: The State of Research in 1986*. Edited by A. Garrard and H. G. Gebel, pp. 39–65. Oxford: British Archaeological Reports International Series No. 396(i).

Scott, T. R. 1977. "The Harifian of the Central Negev," in *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 2: The Avdat/Aqev Area, Part 2 and the Har Harif*. Edited by A. E. Marks, pp. 271–322. Dallas: Southern Methodist University Press.

Sellet, F. 1993. *Châine opératoire:* The concept and its applications. *Lithic Technology* 18:106–112.

Shackley, M. S. 2000. The Stone Tool Technology of Ishi and the Yana of North Central California: Inferences for Hunter-Gatherer Cultural Identity in Historic California. *American Anthropologist* 102:693–712.

Sharon, G. 2007. *Acheulian Large Flake Industries: Technology, Chronology, and Significance*. Oxford, UK: Archaeopress: British Archaeological Reports International Series 1701.

Sharon, G. 2008. The impact of raw material on Acheulian large flake production. *Journal of Archaeological Science* 35:1329–1344.

Sharon, G. 2009. Acheulian Giant Core Technology: A Worldwide Perspective. *Current Anthropology* 50:335–367.

Sharon, G., C. Feibel, N. Alperson-Afil, Y. Harlavan, G. Feraud, S. Ashkenazi, and R. Rabinovich. 2010. New Evidence for the Northern Dead Sea Rift Acheulian. *PaleoAnthropology* 2010:79–99.

Sharon, G., and N. Goren-Inbar. 1999. Soft percussor use at the Gesher Benot Ya'aqov Acheulian site? *Journal of the Israel Prehistoric Society* 28:55–79.

Shea, J. J. 1988. Spear Points from the Middle Paleolithic of the Levant. *Journal of Field Archaeology* 15:441–450.

Shea, J. J. 1991. The Behavioral Significance of Levantine Mousterian Industrial Variability. Doctoral Dissertation, Harvard University.

Shea, J. J. 1998. Neandertal and early modern human behavioral variability: A regional-scale approach to the lithic evidence for hunting in the Levantine Mousterian. *Current Anthropology* 39:S78–S78.

Shea, J. J. 2003. The Middle Paleolithic of the East Mediterranean Levant. *Journal of World Prehistory* 17:313–394.

Shea, J. J. 2006a. Child's play: Reflections on the invisibility of children in the paleolithic record. *Evolutionary Anthropology* 15:212–216.

Shea, J. J. 2006b. The origins of lithic projectile point technology: evidence from Africa, the Levant, and Europe. *Journal of Archaeological Science* 33:823–846.

Shea, J. J. 2007a. Behavioral Differences between Middle and Upper Paleolithic *Homo sapiens* in the East Mediterranean Levant: The Roles of Intraspecific Competition and Dispersal from Africa. *Journal of Anthropological Research* 64:449–488.

Shea, J. J. 2007b. "Lithic Archaeology, or, What Stone Tools Can (and Can't) Tell Us About Early Hominin Diets," in *Evolution of the Human Diet: The Known, the Unknown and the Unknowable*. Edited by P. Ungar, pp. 321–351. Oxford, UK: Oxford University Press.

Shea, J. J. 2008. The Lower and Middle Paleolithic in the Middle East and neighboring regions. *Evolutionary Anthropology* 17:205–207.

Shea, J. J. 2010. "Stone Age Visiting Cards Revisited: A Strategic Perspective on the Lithic Technology of Early Hominin Dispersal," in *Out of Africa 1: The First Hominin Colonization of Eurasia*. Edited by J. G. Fleagle, J. J. Shea, F. E. Grine, A. L. Baden, and R. Leakey, pp. 47–64. New York: Springer.

Shea, J. J. 2011a. "The Archaeology of an Illusion: The Middle-Upper Paleolithic Transition In The Levant," in *The Lower and Middle Palaeolithic in the Middle East and Neighbouring Regions*. Edited by J.-M. Le Tensorer, R. Jagher, and M. Otte, pp. 169–182. Liège: Etudes et Recherches Archéologiques de l'Université de Liège (ERAUL).

Shea, J. J. 2011b. *Homo sapiens* is as *Homo sapiens* was: Behavioral Variability vs. "Behavioral Modernity" in Paleolithic Archaeology. *Current Anthropology* 52:1–35.

Shea, J. J. 2011c. Refuting a Myth of Human Origins. *American Scientist* 99:128–135.

Shea, J. J. 2011d. "Sorting Out the Muddle in the Middle East: Glynn Isaac's Method of Multiple Working Hypotheses Applied to Theories of Human Evolution in the Late Pleistocene Levant," in *Casting the Net Wide: Papers in Honor of Glynn Isaac and His Approach to Human Origins Research*. Edited by J. M. Sept and D. R. Pilbeam, pp. 213–231. Cambridge, MA: American School of Prehistoric Research/Peabody Museum Press.

Shea, J. J. 2011e. Stone Tool Analysis and Human Evolution: Some Advice from Uncle Screwtape. *Evolutionary Anthropology* 20:48–53.

Shifroni, A., and A. Ronen. 2000. "Observations on the Yabrudian of Tabun Cave, Israel," in *Toward Modern Humans: Yabrudian and Micoquian, 400–50 kyears ago*. Edited by A. Ronen and M. Weinstein-Evron, pp. 119–131. Oxford: British Archaeological Reports International Series S850.

Shott, M. J. 1986. Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Anthropological Research* 42:15–51.

Shott, M. J. 1996. An Exegesis of the Curation Concept. *Journal of Anthropological Research* 52:259–280.

Simmons, A. H. 2007. *The Neolithic Revolution in the Near East: Transforming the Human Landscape*. Tucson, AZ: University of Arizona Press.

Simmons, A. H., and M. Najjar. 2006. Ghwair I: A Small, Complex Neolithic Community in Southern Jordan. *Journal of Field Archaeology* 31:77–95.

Simms, S. R. 1983. The Effects of Grinding Stone Reuse on the Archaeological Record in the Eastern Great Basin. *Journal of California and Great Basin Archaeology* 5:98–102.

Skinner, J. 1970. El Masloukh: A Yabroudian site in Lebanon. *Bulletin du Musée de Beyrouth* 23:143–172.

Slimak, L., S. L. Kuhn, H. Roche, D. Mouralis, H. Buitenhuis, N. Balkan-Atli, D. Binder, C. Kuzucuoglu, and H. Guillou. 2008. Kaletepe Deresi 3 (Turkey): Archaeological evidence for early human settlement in Central Anatolia. *Journal of Human Evolution* 54:99–111.

Solecki, R. L. 1963. Prehistory in the Shanidar Valley, Northern Iraq. *Science* 139:179–193.

Solecki, R. L. 1971. *Shanidar: The First Flower People*. New York: Alfred A. Knopf.

Solecki, R. L., and R. Solecki. 1970. A new secondary flaking technique at the Nahr Ibrahim Cave site (Lebanon). *Bulletin du Musée de Beyrouth* 23:137–142.

Solecki, R., and R. L. Solecki. 1986. A Reappraisal of Rust's Cultural Stratigraphy of Yabroud Shelter I. *Paléorient* 12:53–60.

Solecki, R. L., and R. L. Solecki. 1995. "The Mousterian Industries of Yabrud Shelter 1: A Reconsideration," in *The Definition and Interpretation of Levallois Technology*. Edited by H. L. Dibble and O. Bar-Yosef, pp. 381–398. Madison, WI: Prehistory Press Monographs in World Archaeology No. 23.

Speth, J. D., and J. L. Clark. 2006. Hunting and overhunting in the Levantine Late Middle Palaeolithic. *Before Farming* 3:Article 1.

Stearcy, M. T. 2011. *Life-Giving Stone: Ethnoarchaeology of Maya Metates*. Tucson, AZ: University of Arizona Press.

Stekelis, M. 1966. *Archaeological Excavations at 'Ubeidiya, 1960–1963*. Jerusalem: Israel Academy of Sciences.

Stekelis, M., and D. Gilead. 1966. *Maayan Barukh, A Lower Paleolithic Site in Upper Galilee (in Hebrew)*. Jerusalem: Center for Prehistoric Research.

Stiner, M. C. 2006. *The Faunas of Hayonim Cave, Israel: A 200,000-Year Record of Paleolithic Diet, Demography, and Society*. Cambridge, MA: Peabody Museum Press, Harvard University.

Stiner, M. C., and S. L. Kuhn. 2006. Changes in the Connectedness and Resilience of Paleolithic Societies in Mediterranean Ecosystems. *Human Ecology* 34:693–712.

Stordeur, D. 1989. El Kowm 2 Caracol et le PPNB. *Paléorient* 15:102–110.

Stordeur, D., and F. Abbès. 2002. From Pre-Pottery Neolithic A to Pre-Pottery Neolithic B: On spotlight, from a transition phase to Jerf el Ahmar (Syria). *Bulletin de la Societe Prehistorique Francaise* 99:563–595.

Sullivan, A. P., III, and K. C. Rozen. 1985. Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50:755–779.

Surovell, T. A. Editor. 2009. *Toward a Behavioral Ecology of Lithic Technology: Cases from Paleoindian Archaeology*. Tucson, AZ: University of Arizona Press.

Suzuki, H., and F. Takai. Editors. 1970. *The Amud Man and His Cave Site*. Tokyo: Academic Press of Japan.

Tactikos, J. C. 2005. A Landscape Perspective on the Oldowan from Olduvai Gorge, Tanzania. Doctoral Dissertation, Rutgers University.

Tchernov, E. 1987. The Age of the 'Ubeidiya Formation, an Early Hominid Site in the Jordan Valley. *Israel Journal of Earth Sciences* 36:3–36.

Tchernov, E. 1988. "The Biogeographical History of the Southern Levant," in *The Zoogeography of Israel*. Edited by Y. Yom-Tov and E. Tchernov, pp. 401–409. Dordrecht: Junk.

Tchernov, E. 1996. Rodent faunas, chronostratigraphy and paleobiogeography of the southern Levant during the Quaternary. *Acta Zoologica Cracoviensis* 39:513–530.

Tchernov, E. 1998. "The Faunal Sequences of the Southwest Asian Middle Paleolithic in Relation to Hominid Dispersal Events," in *Neandertals and Modern Humans in Western Asia*. Edited by T. Akazawa, K. Aoki, and O. Bar-Yosef, pp. 77–90. New York: Plenum.

Tchernov, E. 1999. "The earliest hominids in the southern Levant," in *Los Homínidos y su entorno en el Pleistoceno inferior y medio de Eurasia: Proceedings of the International Conference on Human Palaeontology, Orce, Spain, 1995*. Edited by J. Gilbert, F. Sánchez, L. Gilbert, and F. Ribot, pp. 389–406. Orce, Spain: Museo de Prehistoria y Paleontologia.

Thomson, D. F. 1939. The Seasonal Factor in Human Culture. *Proceedings of the Prehistoric Society* 10:209–221.

Tixier, J. 1963. *Typologie de L'Epipaleolithique du Maghreb*. Paris: Arts et Metiers Graphiques.

Torrence, R. 1989. "Re-tooling: Towards a Behavioral Theory of Stone Tools," in *Time, Energy, and Stone Tools*. Edited by R. Torrence, pp. 57–66. Cambridge, UK: Cambridge University Press.

Torrence, R. 2001. "Hunter-Gatherer Technology: Macro- and microscale approaches," in *Hunter-Gatherers: An Interdisciplinary Perspective*. Edited by C. Panter-Brick, R. H. Layton, and P. Rowley-Conwy, pp. 73–98. Cambridge, UK: Cambridge University Press.

Tostevin, G. 2003. "A quest for antecedents: A comparison of the Terminal Middle Paleolithic and Early Upper Paleolithic of the Levant," in *More Than Meets the Eye: Studies on Upper Paleolithic Diversity in the Near East*. Edited by A. Belfer-Cohen and N. Goring-Morris, pp. 54–67. Oxford, UK: Oxbow Books.

Toth, N., J. D. Clark, and G. Ligabue. 1992. The Last Stone Axe Makers. *Scientific American* 263:88–93.

Toth, N., and K. Schick. 2009. The Oldowan: The Tool Making of Early Hominins and Chimpanzees Compared. *Annual Review of Anthropology* 38:289–305.

Toth, N. P. 1987. Behavioral inferences from early stone artifact assemblages: An experimental model. *Journal of Human Evolution* 16:763–787.

Toth, N. P. 1997. "The Artifact Assemblages in the Light of Experimental Studies," in *Koobi Fora Research Project Series, Volume 5: Plio-Pleistocene Archaeology*. Edited by G. Isaac and B. Isaac, pp. 363–402. Oxford, UK: Clarendon.

Tufte, E. 1990. *Envisioning Information*. Cheshire, CT: Graphics Press.

Turville-Petre, F. Editor. 1927. *Researches in Prehistoric Galilee: 1925–1926*. London: British School of Archaeology in Jerusalem.

Turville-Petre, F. 1932. Excavations in the Mugharet el-Kebara. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 62:271–276.

Twiss, K. C. 2007. The Neolithic of the Southern Levant. *Evolutionary Anthropology* 16:24–35.

Valla, F. 1995. "The First Settled Societies – Natufian (12,500–10,200 BP)," in *Archaeology of Society in the Holy Land*. Edited by T. E. Levy, pp. 169–188. New York: Facts on File.

Valla, F., F. Bocquetin, H. Plisson, H. Khalaily, C. Delage, R. Rabinovich, N. Samuelian, B. Valentin, and A. Belfer-Cohen. 1999. Le Natoufien final et les nouvelles fouilles a Mallaha (Eynan), Israël 1996–1997. *Journal of the Israel Prehistoric Society* 28:105–176.

Verhoeven, M., and P. M. M. G. Akkermans. 2000. *Tell Sabi Abyad II: The Pre-Pottery Neolithic B Settlement. Report on the Excavation of the National Museum of Antiquities Leiden in the Balikh Valley, Syria*. Istanbul: Nederlands Historisch-Archaeologisch Institut te Istanbul.

Villa, P. 1983. *Terra Amata and the Middle Pleistocene Archaeological Record of Southern France*. Berkeley, CA: University of California Press.

Volkman, P., and D. Kaufman. 1983. "A reassessment of the Emireh point as a possible type fossil for the technological shift from the Middle to the Upper Paleolithic in the Levant," in *The Mousterian Legacy: Human Biocultural Change in the Upper Pleistocene*, vol. 164. Edited by E. Trinkaus, pp. 35–51. Oxford, UK: British Archaeological Reports.

Waldron, S. R. 1987. Weighted Digging Sticks in Ethiopia. *South African Archaeological Bulletin* 42:69–71.

Wallace, I. J., and J. J. Shea. 2006. Mobility Patterns and Core Technologies in the Middle Paleolithic of the Levant. *Journal of Archaeological Science* 33:1293–1309.

Watkins, T., D. Baird, and A. Betts. 1989. Qermez Dere and the Early Aceramic Neolithic of N. *Iraq. Paléorient* 15:19–24.

Weinstein-Evron, M., G. Bar-Oz, Y. Zaidner, A. Tsatskin, D. Druck, N. Porat, and I. Hershkovitz. 2003. Introducing Misliya Cave, Mount Carmel, Israel: A New Continuous Lower/Middle Paleolithic Sequence in the Levant. *Eurasian Prehistory* 1:31–55.

Weinstein-Evron, M., D. Kaufman, Tsatskin, A., G. Bar-Oz, T. Dayan, I. Hershkovitz, N. Bachrach, L. Weissbrod, N. Liber, and D. E. Bar-Yosef Mayer. 2008. After 70 years: new excavations at the el-Wad Terrace, Mount Carmel. *Journal of the Israel Prehistoric Society* 37.

Whittaker, J., K. Kamp, and E. Yilmaz. 2009. Çamak Revisited: Turkish Flintknappers Today. *Lithic Technology* 34:93–110.

Whittaker, J. C. 1994. *Flintknapping: Making and Understanding Stone Tools*. Austin, TX: University of Texas Press.

Whittaker, J. C. 2004. *American Flintknappers: Stone Age Art in the Age of Computers*. Austin: University of Texas Press.

Whittaker, J. C., and G. McCall. 2001. Handaxe-Hurling Hominids: An Unlikely Story. *Current Anthropology* 42:566–572.

Wiessner, P. 1983. Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 48:253–276.

Williams, J. 1997. "Tor Aeid, an Upper Paleolithic Site in Southern Jordan," in *The Prehistory of Jordan, II. Perspectives from 1997*. Edited by H.-G. K. Gebel, Z. Kafafi, and G. Rollefson, pp. 137–148. Berlin: ex oriente.

Willoughby, P. 1985. Spheroids and Battered Stones in the African Early Stone Age. *World Archaeology* 17:44–60.

Wiseman, M. F. 1993. Lithic blade elements from the southern Levant: A diachronic view of changing technology and design processes. *Mitekufat Haeven* 25:13–102.

Wobst, M. H. 1977. "Stylistic behavior and information exchange," in *For the Director, Research Essays in Honor of James B. Griffin*, vol. Anthropology Papers 61. Edited by C. Cleland, pp. 317–342. Ann Arbor: Museum of Anthropology, University of Michigan.

Wrangham, R. W. 2009. *Catching Fire: How Cooking Made Us Human*. New York: Basic Books.

Wreschner, E. 1967. The Geula Caves, Mount Carmel: Excavations, Finds, and Summary. *Quaternaria* 9:69–90.

Wright, K. I. 1991. The Origins and Development of Ground Stone Assemblages in Late Pleistocene Southwest Asia. *Paléorient* 17:19–45.

Wright, K. I. 1992. A Classification System for Ground Stone Tools from the Prehistoric Levant. *Paléorient* 18:53–81.

Wright, K. I. 1993. Early Holocene Ground Stone Assemblages in the Levant. *Levant* 25:93–111.

Wright, K. I. 1994. Ground-Stone Tools and Hunter-Gatherer Subsistence in Southwest Asia: Implications for the Transition to Farming. *American Antiquity* 59:238–263.

Wynn, T. 1995. Handaxe enigmas. *World Archaeology* 27:10–24.

Yaroshevich, A., D. Kaufman, D. Nuzhnyy, O. Bar-Yosef, and M. Weinstein-Evron. 2010. Design and performance of microlith implemented projectiles during the Middle and the Late Epipaleolithic of the Levant: experimental and archaeological evidence. *Journal of Archaeological Science* 37:368–388.

Yeivin, E., and Y. Olami. 1979. Nizzanim - A Neolithic site in Nahal Evtah: excavations of 1968–1970. *Tel Aviv* 6:99–135.

Zaidner, Y. 2003. The Lithic Assemblages of Bizat Ruhama: Lower Paleolithic Site in the Southern Coastal Plain, Israel. Master's Thesis, University of Haifa.

Zaidner, Y., D. Druck, and M. Weinstein-Evron. 2006. "Acheulo-Yabrudian handaxes from Misliya Cave, Mount Carmel, Israel," in *Axe Age: Acheulian Toolmaking from Quarry to Discard*. Edited by N. Goren-Inbar and G. Sharon, pp. 243–266. London: Equinox.

Zaidner, Y., A. Ronen, and J.-M. Burdukiewicz. 2003. L'industrie microlithique du Paléolithique inferieur de Bizat Ruhama, Israël. *L'Anthropologie* 107:203–222.

Zeder, M. A. 2011. The Origins of Agriculture in the Near East. *Current Anthropology* 52:S235–S235.

Ziffer, D. 1978. A Re-evaluation of the Upper Palaeolithic Industries at Kebara Cave and Their Place in the Aurignacian Culture of the Levant. *Paléorient* 4:273–293.

Zohary, M. 1973. *Geobotanical Foundations of the Middle East*. Stuttgart: Gustav Fischer Verlag.

INDEX